NOTICE OF MEETING

CITY OF BRANSON

CAPITAL IMPROVEMENT COMMITTEE

Committee Meeting – Monday, February 14, 2011 – 10:30 a.m.
Fish Bowl Conference Room – Branson City Hall – 110 W. Maddux

AMENDED AGENDA

1) Call to Order.

2) Roll Call.

3) 5 Year Capital Budget Update.

4) Consultant Selection Aerial Photography. [Curtis Memo]
[Proposal Aeroquest Optimal] [Proposal Kucera] [Proposal Pictometry]
[Proposal Surdex and Pictometry] [Proposal Woolpert]

5) Meadow Ridge Sewer Connection. [Meadowridge Plan] [Meadowridge Map]
[2011 Private Waste Water Treatment Plants]

6) Discussion of Energy Performance Contract.

7) Capital Project Status Update.

8) Change Order Update.

9) Adjourn.

TO: Capital Improvements Committee

FROM: David Miller

DATE: February 8, 2011

SUBJ: Digital Aerial Photography and Topographic Mapping

The city of Branson's entire GIS system is based upon digital aerial photography. These images are taken with highly specialized cameras from special low-flying airplanes and are extremely accurate. The methods used to capture and process the aerial photography, are also used to develop elevation information and other mapping data. As growth occurs in a community, this information must be updated or it becomes more and more obsolete and inaccurate. Most cities schedule to have new aerial photography done every 3 years. The last time Branson had digital aerial photography flown was in February, 2006. The images now being used do not even show Branson Landing or the major developments in Branson Hills.

The capital request for new aerial photography was initially submitted a few years ago but, unfortunately other higher priorities delayed the funding until 2011. Based upon previous photography contracts an amount of $120,000 was requested in the capital budget. Curtis Copeland, Branson's GIS Coordinator, evaluated several ways to reduce costs for the project and even attempted to do a cost-sharing agreement with the Corps of Engineers but unfortunately, no great cost savings were realized with that approach. Ultimately, Curtis determined it would be most cost effective to simply request proposals for the type of data Branson needs.

An RFP was sent to all firms that can provide the needed products. Five proposals were received. To simplify the review process, firms were limited to 20 pages in their proposals. To reduce paper waste, the proposals were also requested in digital form.

Curtis has prepared the attached detailed review of the proposals. This item is scheduled for consideration at the Capital Improvements Committee on February 14th. A recommendation from the committee will allow the accepted proposals to be approved by the Board of Aldermen so that the photography can be completed before the trees begin to sprout leaves in the spring which will negatively impact the photography.

Curtis and I discussed his recommendation at length and I concur with his analysis and conclusions.

TO: Capital Improvements Committee
FROM: Curtis Copeland
DATE: February 8, 2011
SUBJ: Digital Orthophotography, Digital Topographic Mapping, and Oblique

Digital Orthophotography, Digital Topographic Mapping, and Oblique Photography

Funds were allocated this year to acquire new digital orthogonal and oblique photography (aerials) and updated digital, topographic mapping (2 foot contours). The foundational data set of the City's GIS and mapping applications, is highly accurate, high resolution, digital orthophotography. This base data set also lends itself to other important data layers in the GIS and mapping applications, including topographic and parcel mapping (which is the basis for City Limit and Zoning mapping). As with any geographic data, it must be maintained to ensure its currency and accuracy, especially in an area such as Branson, that has witnessed much growth and change in the topographic landscape since February 2006, when Branson last had aerial photography flown and developed.

There have been a number of technological changes and advancements in the 5 years since the City's last RFP for a product of this type. New airborne sensors, like LIDAR and multi-angle capture oblique photography, have increased the accuracies, data capture techniques, standards, and applications a great deal. These new technologies have also had a positive influence on cost.

The RFP was developed to address these new technologies, and establish a set of specifications that would provide the City a deliverable of digital orthophotography and topographic mapping that meets the standard necessary for the City GIS; as well as acquire a deliverable of oblique photography, that would add a new element to the GIS. The oblique photography has a wide potential for applications and use by emergency services, economic development, and planning.

In accordance with the City ordinance, the Requests for Proposals were sent to all the firms that have submitted their annual qualifications to the City and specialize in similar types of work. Five proposals were received.

Pictometry

Surdex

AeroQuest Optimal

Woolpert

Kucera

The criteria used to evaluate the options were (in order of importance):

Data Deliverable - High

Experience with Similar Projects - High

Ground Control Method - High

Map Accuracy Standard - High

Elevation Model Method - High

Orthogonal Imagery Method - High

2 Foot Contour Development Method - High

Photo Resolution (Ortho) - High

Oblique Imagery Method - High

Photo Resolution (Oblique) - High

Total Project Cost - High

Resources Available (Staff, Equipment, Aircraft) - High

Viewing Software to Be Provided - High

Projection and Coordinate System Requirements - Medium

Camera Systems - Medium

LIDAR Method - Medium

Delivery Schedule - Low

Production Location - Low

The question of "Digital Orthophotography, Digital Topographic Mapping, and Oblique Photography Vendor Selection" was evaluated by means of a decision table.

	Data Deliverable	Experience with Similar Projects	Ground Control Method	Map Accuracy Standard	Elevation Model Method	Orthogonal Imagery Method	2 Foot Contour Development Method	Photo Resolution (Ortho)	Oblique Imagery Method	Photo Resolution (Oblique)	Total Project Cost	Resources Available (Staff, Equiment, Aircraft)	Viewing Software to Be Provided	Projection and Coordinate System Requirements	Camera Systems	LIDAR Method	Delivery Schedule	Production Location	Summary
Pictometry	Excellent	Good	Excellent	Fair	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Good	Excellent	Excellent
Surdex	Excellent	Good	Excellent	Good	Excellent	Excellent	Excellent	Good	Excellent	Excellent	Good	Excellent	Excellent	Good	Excellent	Excellent	Good	Excellent	Excellent
AeroQuest Optim	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Good	Good	Fair	Good	Good	Excellent	Excellent	Excellent	Excellent	Good	Excellent
Woolpert	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Good	Good	Good	Good	Good	Excellent	Excellent	Good	Excellent	Excellent	Excellent
Kucera	Good	Good	Good	Excellent	Good	Good	Good	Fair	Good	Good	Excellent	Excellent	Good	Fair	Good	Fair	Excellent	Good	Good

Decision Table for Digital Orthophotography, Digital Topographic Mapping, and Oblique Photography Vendor Selection

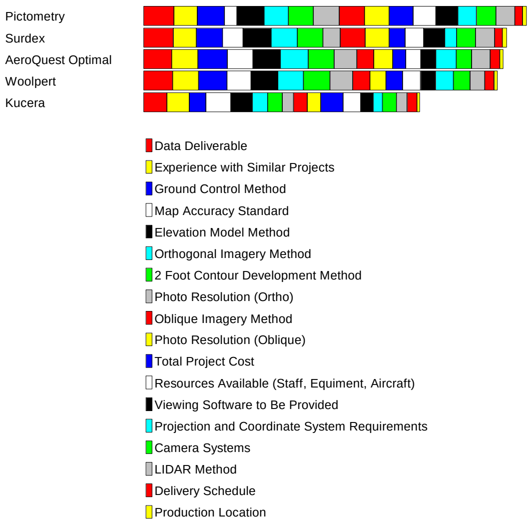
Alternative choices considered are listed down the left side of the table. The criteria used to evaluate the various options are listed along the top. Initially entered in no particular order, both the choices and the criteria were then repositioned according to importance of criteria and effectiveness of individual choices in meeting them.

As criteria are evaluated and weights assigned according to which factors are considered to be most significant, the factors are sorted from left to right in order of importance (i.e., the factor considered by the decision maker to be most significant in meeting overall needs ends up in the leftmost position).

Similarly, as choices are evaluated according to effectiveness in meeting criteria, the best choices migrate to the top of the list. When the process is complete, the best choice should emerge at the top.

As selection alternatives and the criteria to be used in evaluating them are entered into the table, weights are assigned to each of the evaluation factors so that they are ranked in order of their importance in fulfilling the overall task.

Relative strengths of the various choices in each of the factors are illustrated in the following graph:



Because of the specialized, oblique aerial photography, technology, there are a very few companies worldwide that have these capabilities. For this reason, three of the five vendors who submitted proposals have teamed with other companies to provide the digital oblique cameras and necessary processing systems necessary to meet the requirements of the RFP. Two of the firms submitting proposals have the equipment and technology to capture all elements of the proposal without teaming.

The Capital Improvements Committee has stated that it has been helpful to know staff's thoughts in regards to the proposals. With this in mind, I am providing the following notes and reactions that I concluded when I read the proposals. This is not intended to sway committee opinion, just to help clarify the selection process.

Pictometry: This company has developed and patented a high-resolution, oblique photography system, that has the ability to capture the orthogonal photography at the same time. They have also developed viewing software for their imagery, which integrates with the GIS software that the City currently uses. Accurate, orthogonal (overhead), aerial photography is still an important foundational dataset for the City of Branson. Pictometry has developed a system called Accuplus to directly address the orthogonal photo product.

Surdex: This company has past experience with the City of Branson, on a similar project in the Spring of 1999. The photography and topographic data from that project served as a base for the City's GIS at that time. Surdex will be teaming with Pictometry to meet the oblique photography requirement. The orthogonal photos and 2' contour topography mapping will be completed by Surdex. Surdex has much experience with photography and mapping in City's region.

AeroQuest Optimal: This company had a very detailed proposal. Optimal, will be teaming with Geospan. Geospan will be providing their oblique photography solution to meet the requirement. Geospan also has viewing software available for their oblique imagery.

Woolpert: This company has both camera systems available: the traditional orthogonal, and the oblique. The large-format digital, oblique aerial view camera was developed by the company, as well as viewing software that integrates with the City's existing GIS system

Kucera: This company will also be teaming with Geospan to meet the oblique photography requirement. Kucera proposed a lower resolution orthophoto (6" pixel), than suggested in the RFP. This company also states in the RFP that they have LIDAR data captured on January 19th of this year in the Branson area, which may be used on this project.

Proposal Response to the City of Branson, MO

RFP Title: "Digital Orthophotography, Oblique Imagery, and Digital Topographic Mapping"

January 28th, 2011

AEROQUEST
OPTIMAL

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Huntsville, AL 35805-1927
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Fax: 256.882.7774
www.aeroquestoptimal.com

11-058

January 19, 2011

City of Branson, MO
Mr. Curtis J. Copeland, G.I.S. Coordinator
110 W. Maddux Street, Suite 310
Branson, MO 65616

Re: Response to RFP for Digital Orthophotography, Oblique Imagery, & Digital Topographic Mapping

Mr. Copeland:

Aeroquest Optimal, Inc., is pleased to submit the enclosed proposal and pricing for review. We look forward to the opportunity of putting our extensive skills and experience to work on this project. We have performed numerous similar projects with great success. We have extensive understanding of the requirements of the work to be done, and of the topography of Missouri and the Branson area.

Mr. Ronny Taylor will serve as our Project Manager. Mr. Taylor understands the critical role of communication and responsiveness in quality and schedule compliance for the project. His background and personal abilities give the management of the project a strong leader with the knowledge of how to best assess and design all project requirements, communicate and lead team members, and see objectives through to prompt completion. Mr. Taylor has over 33 years of experience in Aerial Photography, Digital Orthophotography, LiDAR, and Photogrammetric Mapping and has managed or worked on numerous county mapping projects across the nation.

OPTIMAL was responsible for well over 20,000 square miles of Photogrammetric and LiDAR surveys in 2009 and 2010. These surveys spanned the spatial extents of the United States and included International surveys in Canada and South America. These projects ranged in size from small local development, airport, and transportation surveys to a large USGS specification compliant project of over 15,000 sq. mi.

Continuing our mission to provide our customers with the best possible data, Aeroquest Optimal owns the latest and most technologically advanced equipment in the industry including the new Intergraph DMC (**Z/I DMC II 230**) digital camera. Additionally we own an Optech ALTM 3100, 100 KHz LiDAR system and traditional Leica RC-30 film cameras and we plan to acquire a new Optech GEMINI LiDAR sensor in 2011. Our equipment capacity not only improves our ability to deliver quality products but also allows us to respond to and complete projects in shorter timeframes. Our professional staff consists of over 50 personnel, including FAA Licensed Pilots, ASPRS Certified Photogrammetrists, and Professional Land Surveyors in 14 states. Additionally, we operate numerous aircraft including Cessna and Piper models.

Aeroquest Optimal strives to reach beyond the typical client relationship to form a client partnership. We appreciate our customer relationships and are committed to working together with you to achieve your goals. If you have any questions, or if we may assist you in any way, please call me at (256) 882-7788.

Sincerely,

Mark W. Brooks
Vice President & General Manager

QUALIFICATIONS STATEMENT

Company Background and Information:

In business continuously since 1961, our staff is a full-service Photogrammetric Mapping, LiDAR and Surveying firm. OPTIMAL maintains state of the art production facilities with one of the largest number of photogrammetric instruments available in the private sector today. Our aerial acquisition equipment includes numerous aircraft, a new **Intergraph DMC** digital sensor (**Z/I DMC II 230**), two (2) Leica RC-30 cameras, equipped with IMU, one Optech 1210 LiDAR unit, one Optech ALTM 3100 LiDAR unit with integrated medium format digital aerial camera. We also anticipate acquiring a new Optech Gemini LiDAR unit in 2011.

OPTIMAL continually strives to ensure we have the most technologically advanced operation in the industry as well as the most highly trained, certified and competent personnel on staff. OPTIMAL has a long list of satisfied customers able to attest to the excellence and precision of our products as well as our dedication to customer satisfaction. Our 49 years in the industry and decades of successful projects attests to our stability in the industry.

OPTIMAL's team consists of over 50 highly-trained personnel including Aerial Photographers, LiDAR Analysts, LiDAR Technicians, Certified Photogrammetrists, Professional Land Surveyors, Pilots, Digital Orthophotography Technicians, Corridor Specialists, Topographic Mapping Specialists, Planimetric Mapping Specialists, Analysts and other experts. Our professional team has extensive experience in aerial photography, LiDAR acquisition and processing, conventional and GPS surveying, topographic mapping, planimetric mapping, DTM/DEM development, GIS services, digital orthophotography, scanning, photogrammetric compilation, analytical aerial triangulation, thermal mapping, volumetric and stockpile calculation and photo lab processing.

Firm Address and Contact Information:

Aeroquest Optimal, Inc.
Email: info@optimalgeo.com
4975 Bradford Drive, Suite 100
Huntsville, AL 35805
Phone: (256) 882-7778
Fax: (256) 882-7774
www.aeroquestoptimal.com
info@optimalgeo.com

Aeroquest Optimal's Huntsville, AL Headquarters

The Year the Firm was Established:

2010 / State of Incorporation: Delaware; Originally established in 1961

The Type of Ownership:

U.S. Corporation registered in Delaware.

The Location of the Office that would provide Project Services:

Aeroquest Optimal, Inc.
4975 Bradford Drive, Suite 100
Huntsville, AL 35805

Qualifications of key personnel to be used for the project:

(1) ASPRS Certified Photogrammetrists (CP);
- **Mr. Mike Vessel,** #1361, (13 years of experience)
- **Mr. Chris Jaeger,** #1458, (29 years of experience)

(2) Registered Professional Photogrammetrists (RPP) in Oregon on staff;
- **Mr. Mike Vessel,** #80693RPP, (13 years of experience)

(3) Licensed Surveyor Photogrammetrist (SP) in Virginia on staff;
- **Mr. Mike Vessel,** #0408000011, (13 years of experience)
- **Mr. Mark Brooks,** #0408000160, (18 years of experience)
- **Mr. Chris Jaeger,** #0408000109, (29 years of experience)

(4) Professional Land Surveyors on staff:
- **Mr. Dean Epling, #**LS5417, (23 years of experience)
- **Mr. Richard A. Lehr,** in 14 states, **MO #002643**, (45 years of exp.)

(5) GISCI Certified GIS Professionals (GISP) on staff:
- **Mr. Mike Vessel,** #45872, (13 years of experience)
- **Mr. Chris Jaeger,** #45557, (29 years of experience)
- **Mr. Robert Yao-Kumah,** #63193, (11 years of experience)

(6) Professional Surveyor and Mapper in Florida (PSM) on staff;
- **Mr. Dean Epling,** #LS5417, (23 years of experience)
- **Mr. Richard Lehr**, #LS3750, (45 years of experience)

Company Data / Information:

(1) Certificate of Authorization (COA) of Firm to Practice Land Surveying:
- **State of Missouri** #2011000155

(2) Registered to do Business in: **Missouri**

(3) Company Identification Numbers:
- **EIN/TIN:** # 04-3831576
- **DUNS:** # 612144464
- **CAGE:** # 47YG5
- **NAICS:** # 541360, # 541370

(4) Corporate Officers / Directors:
- **Mr. Roy T. Graydon**, President
- **Mr. Mark Brooks**, Vice President, General Manager
- **Mr. Robert Motz,** Corporate Secretary, CFO
- **Mr. Jerry Burnham**, Assistant Secretary

(5) Business Size Standard / Classification:
- **Large Business** (Corporation)

(6) Number of Employees:
- **50**

(7) Office Locations:
- Huntsville, AL; Melbourne, FL; Bluffton, SC; Sharpsburg, GA, **St. Louis, MO**

Subcontractor for Oblique Imagery

GEOSPAN Corporation
Mr. Steve Gilkey
Email: gilkey@geospan.com
sales@geospan.com
support@geospan.com
10900 73rd Avenue North, Suite 136
Minneapolis, Minnesota 55369
www.geospan.com
1-800-GEOSPAN
Ph. (763) 493-9320

GEOSPAN's similar project experience includes oblique aerial imagery collection in Vancouver, Calgary, Boston, Chicago, Philadelphia, Denver, San Francisco, Sacramento, Austin, Houston, Dallas, Las Vegas, Phoenix, Naples, Minneapolis-St. Paul, San Diego, Portland, Seattle, and Disney World. Since 1990, GEOSPAN's primary market is serving the needs of local government. GEOVISTA® oblique imagery is utilized or selected for collection in a wide variety of local government entities ranging from the second most populated County in the US to very rural Counties. 2010 oblique aerial projects include Cook County, IL, Hamilton and Pike County, OH, Green Lake County, WI, Masonville and Oscoda County, MI, Calhoun County, FL, Gwinnett County, GA, Newport News, VA and City of Yonkers, NY.

GEOVISTA® technology uniquely provides the following capabilities:

Imagery Flexibility - GEOVISTA® Oblique Aerial 21 mega-pixel cameras provide the ultimate flexibility in:

- Higher resolution
- Larger geographical coverage provided with each image
- Higher image capture frequency to provide more over lapping perspective views
- Image tiling to significantly improve the network speed to retrieve each image

Superior and controllable accuracy - GEOVISTA® Oblique Aerial imagery capabilities include an **accuracy commitment** of not less than 2 meters at 90% confidence interval, within optimal viewing portion of images per National Standard for Spatial Data Accuracy (NSSDA). This paradigm shift in oblique imagery accuracy is based on patented Direct Imagery Measurement rather than a dependency on an existing DTM to provide spatial information.

GEOSPAN is the advanced Photogrammetric industry provider of the highest resolution, most accurate, multi-angle oblique aerial and integrated 360° street-level imagery available.

GEOVISTA® imagery products form the foundation for the future of visual search, 3D modeling and maps online using a high precision, low-cost, patented process. GEOVISTA® imagery allows users to see every location from every angle in a given area and measure anything accurately. GEOVISTA Orthophotography meets National Map Accuracy Standards (NMAS). GEOVISTA® Virtual Tours, 3D Model Generation, and Quantitative Stereo Models are available to enhance your analytical viewing experience.

GEOSPAN supports a variety of state and local government GIS applications including E9-1-1, emergency management, homeland security, law enforcement, planning, property assessing and addressing, infrastructure inventory, pavement analysis, and transportation.

Submittal Content

1. Professional experience and technical competence in providing photogrammetric and G.I.S. services to local governments. (Professional experience and technical competence of the firm with respect to the scope of services requested.)

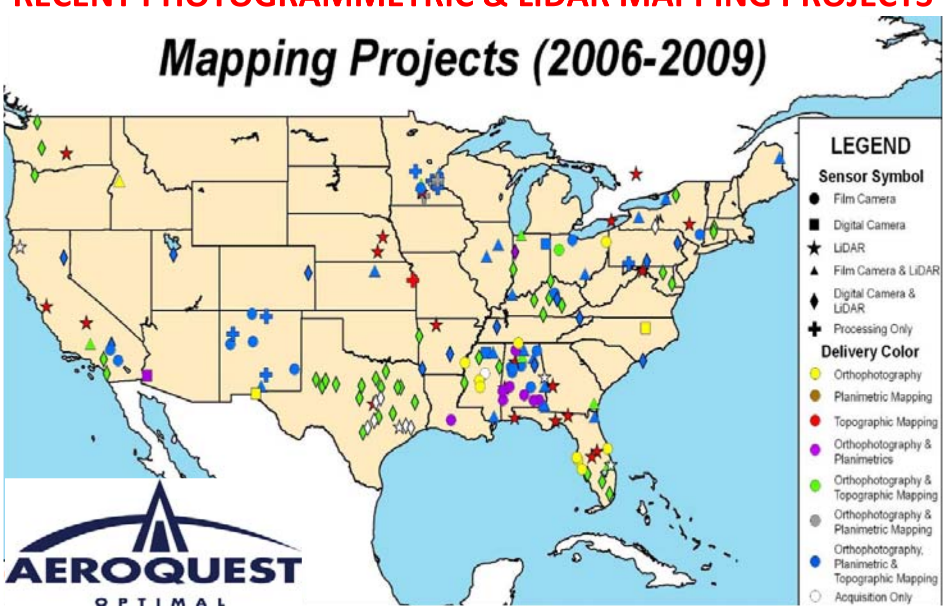
OPTIMAL and its team employs an experienced and qualified staff of surveying and mapping professionals. The Project Manager for the City of Branson project is Mr. Ronny Taylor. He has 33 years of mapping and surveying experience and has managed literally hundreds of city and countywide project. Our Vice President and General Manager, Mr. Mark Brooks, has 19-years of surveying and mapping experience and holds degrees in Civil Engineering and Land Surveying. He is considered one of the leading experts in the industry. Many of OPTIMAL's Department Managers and Lead Technicians hold degrees in the geospatial professions and each have over a decade of experience in the photogrammetric and surveying fields. Additionally, OPTIMAL employs three (3) Certified GIS professionals.

OPTIMAL's Huntsville, AL facility will be the primary production office. This state-of-the-art production facility is one of the largest and most technologically advanced surveying and mapping operations in the private sector today. It includes a large number of advanced photogrammetric workstations, digital orthophotography production workstations, LiDAR and survey processing workstations and CADD/GIS processing workstations. OPTIMAL's data acquisition equipment includes a new Intergraph DMC 230 large format digital camera, USGS certified RC-30 aerial mapping cameras, other digital mapping cameras, LiDAR sensors and a wide assortment of photogrammetric and GPS surveying equipment.

OPTIMAL has successfully delivered over 5,000 square miles of orthophotography in the last 12 months and well over 20,000 square miles over the last five years. The development of high quality accurate digital orthophotography products has been a consistent product offering by OPTIMAL for the last fifteen years. These products have been developed from a variety of film bases and source imagery including but not limited to Black and White film, Color film, Color Infrared film, and digital multispectral imagery.

Customer Testimonial (Mississippi State Government): OPTIMAL received an evaluation stating: *"Frequently Exceeds, and Consistently Exceeds Expectations."* and: *The Consultant often or always exceeds expectations for this category. The Consultant exceeds expectations repeatedly or everytime.*

RECENT PHOTOGRAMMETRIC & LIDAR MAPPING PROJECTS



2. Specific experience of staff to be assigned to the project and contact information of staff members. (Professional experience and technical competence of the individuals to be assigned with respect to the scope of services requested.)

AEROQUEST OPTIMAL Personnel Qualifications:

Name	**Mark W. Brooks, SP, Vice President & General Manager**
Workload	Availability 10%
Education	BS / Land Surveying / Purdue University / 1990 BS / Civil Engineering / Purdue University / 1990
Years Exp.	OPTIMAL: 10 Other Firms: 10
Credentials	Surveyor Photogrammetrist in Virginia, #408000160
Experience Summary	Mr. Brooks has over fourteen years management experience in collecting, processing and estimating Airborne LiDAR projects. He has managed complex LiDAR projects including flight planning, establishing GPS Master Stations, LiDAR data post processing, DEM generation, and development of accurate contour and spot elevation information. He has also managed the generation of break lines from LiDAR gray scale images. He has extensive experience with FEMA mapping specs and Spatial Data Standards. Project

Name	**Ronny Taylor, Project Manager**
Workload	Availability 30%
Education	Certificate / Drafting / Limestone County Technical Center
Years Exp.	OPTIMAL: 33 Other Firms: 0
Credentials	Certificate / Detail Draftsman / Limestone County Technical Center / Athens, AL
Experience Summary	Mr. Taylor has over thirty-three years of Photogrammetric Mapping and Aerial Survey experience in the industry and with our company. He has performed, planned, managed all aspects of mapping operations including Stereo Compilation, Digital Terrain Modeling, Cross Sectioning (Volumetric Calculations), Digital Orthophotography, Planimetric, and Topographic Mapping. He is knowledgeable in first order Analog, Analytical, and Digital (softcopy) Photogrammetric Instrument operations. As a Project Manager he is responsible for the supervision, activities, workflow and coordination of the photogrammetry and/or LiDAR projects. He provides a constant interface with clients and production resources. He communicates clear direction and project status to both the client and OPTIMAL staff. Maintains interface with existing OPTIMAL clients and production resources. Develops additional opportunities with these clients by adding value whenever possible. Establishes and cultivates client and professional relationships which creates repeat business, referrals, professional references, and partnerships. Reviews potential projects and develops the technical design, direction, and approach via the RFP process and company procedures. Is an active participant in the estimation process for projects during the RFP or price response phase. Conducts short list presentations with sales and establishes liaison with clients.

Name	**Richard A. Lehr, PLS, PSM, - Professional Land Surveyor in Missouri**
Workload	Availability 10%
Education	AAS / Civil Technology / Hudson Valley Community College, Troy, NY / 1964
Years Exp.	OPTIMAL: 7 Other Firms: 38
Credentials	MO PLS #2643; and PLS in MS, AR, IN, MD, NC, PA, KY, NY, OH, SC, NJ, MO, AL, FL
Experience Summary	Mr. Lehr has a diversification of field and office experience in the areas of land surveying, photogrammetry and Civil Engineering. He is a member of multiple state and national professional surveying organizations and is licensed in fourteen (14) states including Florida. He has worked with US Army Corps of Engineer (USACE) Districts since 1978, and has 45 years of directly relevant and extensive experience.

Name	**Michael D. Vessel, CP, GISP, RPP, SP, - QA-QC, Certified Photogrammetrist**
Workload	Availability 20%
Education	BS / New Mexico State University / Geography / 1997

Years Exp.	OPTIMAL: 12
Credentials	ASPRS Certified Photogrammetrist, #1361 Certified GIS Professional, GISCI, #00045872 / 2006 Registered Professional Photogrammetrist in Oregon, #80693RPP Surveyor Photogrammetrist in Virginia, #408000011
Experience Summary	Mr. Vessel is responsible for photogrammetric approval and sign off, quality control coordination, and departmental reports for clients.

Name	**Robert Yao-Kumah, GISP, Geodetic Surveyor Technician**
Workload	Availability 100% during acquisition
Education	MA / Geographic Information Sciences / Clark University, Worcester MA / 2004 BS / Mine Surveying / University of Science and Technology, GHANA / 1997
Years Exp.	OPTIMAL: 5 Other Firms: 6
Credentials	Certified GIS Professional, GISCI, #00063193 / 2009
Experience Summary	Mr. Yao-Kumah is an experienced surveying technician with a wide range of professional and academic photogrammetric and GIS skills. He has over eleven (11) years of experience in surveying, mapping, and GIS software development. He is experienced with the following equipment: Leica, Topcon and Sokkia Total Station Theodolites, level instruments, and GPS.

Name	**Hugo Sanchez-Sandoval, Senior Imagery Acquisition Technician**
Workload	Availability 100% during acquisition
Education	BS / Industrial Chemical Engineering / Tech Institute of Aguascalientes Mexico / 1987 Financial Administration Management / University of Aguascalientes, Mexico / 1990-1993
Years Exp.	OPTIMAL: 5 Other Firms: 19
Experience Summary	Mr. Sanchez-Sandoval is an experienced LiDAR data acquisition technician, Aerial Photographer and GPS surveyor with a wide range of professional photogrammetric and engineering skills. He has extensive experience in LiDAR collection, aerial photography, surveying, and geodetic surveying.

Name	**Robert Green, Mapping Technician**
Workload	Availability 20%
Education	BS / Geography with emphasis in GIS / The Ohio State University / Columbus, OH / March 2007
Years Exp.	OPTIMAL: 3 Other Firms: 0
Experience Summary	Mr. Green is an experienced LiDAR Analyst and Map Finishing Technician responsible for performing precision tasks including the processing, manipulation, extraction and archiving of LiDAR data. His tasks are related to the geo-referencing and classification of LiDAR data returns obtained from a LiDAR sensor. Additionally, he performs precision data processing tasks including the processing, management, manipulation and archiving of LiDAR data.

Name	**Tomas Perdomo, Process Manager – Photogrammetry / LiDARgrammetry**
Workload	Availability 20%
Education	Defense Mapping Agency / Photogrammetry / Inter-American Geodetic Survey and Cartographic School / U.S. Army / Panama / 1981
Years Exp.	OPTIMAL: 10 Other Firms: 17
Experience Summary	Mr. Perdomo manages the Photogrammetry Department and possesses over twenty-seven (27) years of relevant experience in LiDARgrammetry, cartography, GIS, and photogrammetry. He is involved in planning, cost estimation, proposal preparation, production scheduling, tracking, hiring, training, and quality control.

Name	**Chris Lamons, Mapping Process Manager**
Workload	Availability 20%
Education	AS / Drafting and Design Technologies / JF Drake State Technical College / AL / 1997 Certificate / Drafting and Design Technologies / Ernest Pruett Technical Inst., Hollywood, AL / 1996
Years Exp.	OPTIMAL: 13 Other Firms: 1
Experience	Mr. Lamons has thirteen (13) years of extensive experience in the management, data processing, and generation of digital orthophotos. He is an expert in orthophotography, DEM processing, and

Summary	DTM and contour production

Name	**Wanda Miller, Orthophotography and Mapping Technician**
Workload	Availability 20%
Education	AS / Drafting / Jackson County Technical School / 1982 CADD Certificate / CAD / J.F. Drake Community College / 1985
Years Exp.	OPTIMAL: 27 Other Firms: 1
Experience Summary	Ms. Miller has twenty-seven (27) years of extensive experience in digital cartography, orthophotography, drafting, volumetric calculations, and digital imagery processing. She is an expert in digital orthophotography, DEM processing, image mosaicking, and DTM and contour production.

GEOSPAN Personnel Qualifications:

The Oblique Imaging Services Project Team:

GEOSPAN has a broad technical background. Its knowledge and experience include: surveying, mapping, photogrammetry, cartography, Geographic Information Systems (GIS), navigation, Global Positioning Systems (GPS), Inertial Navigation Systems (INS), computer systems and networks, video technology, computer imaging, database management and dynamic segmentation techniques.

Theodore M. Lachinski - President and founder of GEOSPAN

Education

University of Minnesota
USMCR Aerial Navigator

Highlights and Qualifications

Mr. Lachinski has thirty years experience developing innovative technological solutions. He has served as GEOSPAN's President and as a director since the company's inception in June 1990. Prior to founding GEOSPAN, Mr. Lachinski served as a Vice President of Technology for UltiMap Corporation and as the Systems and Data Processing Manager for Hennepin County MN, where he was directly responsible for the development of their Property Mapping and Highway Information Systems. He is the primary inventor of the GEOSPAN patent and a pioneer in the spatial information industry. In addition, Mr. Lachinski was a ten-year member of the City Council for Andover, Minnesota.

Stephen H. Boggs - Vice President of Technology

Education

B.S., Honors, Biology, University of Illinois

Highlights and Qualifications

Mr. Boggs has 24 years experience providing system integration services. He has worked for GEOSPAN Corporation since 1992 with responsibility for developing the real time data acquisition and control software as well as GEOVISTA viewing software in end-user systems. Mr. Boggs is a co-inventor of the GEOVISTA process and has overall responsibility for the development and maintenance of all GEOVISTA software.

Jeffrey Setterholm - Geodetic Scientist

Education

B.S., Cum Laude, Engineering and Applied Science, Yale University
M.S., Science & Mathematics, Washington University
United States Air Force, Reese AB, Texas, 1970.Undergraduate Pilot Training
(Distinguished Graduate)
George AFB, California, 1970. F-4C ("Phantom") Combat Crew Training.

Highlights and Qualifications

Mr. Setterholm is a Geodetic Scientist with 24 years experience in applied spatial mathematics and is directly responsible for the development of GEOSPAN's 6-DOF data collection/processing and non-coplanar desktop surveying systems including GPS/INS post-processing and analytical support. He joined GEOSPAN Corporation in

1994 is also the inventor of GEOSPAN's U.S. Patent Pending – "Any Aspect Passive Volumetric Imaging Method." This pending patent automates surveying from imagery by creating 3D visualizations from multiple spatially accurate images.

Steven H. Gilkey – Project Manager

Education

Arizona State University B.S. Degree 1981; Major Business Administration

Highlights and Qualifications

Mr. Gilkey has twenty years of product development experience in the information technology industry. Since joining GEOSPAN Corporation in early 1996, Mr. Gilkey has been involved with all aspects of product development and project management of GEOSPAN's Government Sector offerings. Mr. Gilkey will be the GEOSPAN Project Manager.

Dennis Lockwald - Field Data Collection Manager

Education

Brown Institute Computer Networking 2003

Highlights and Qualifications

Mr. Lockwald Joined GEOSPAN in 2003 with a strong computer hardware and software understanding gained from his education along with an interest in technology. In 2005, Mr. Lockwald was promoted to Field Crew Manager after gaining a strong understanding of the best practices needed in the field to ensure quality data results.

Mr. Lockwald will oversee the imagery post-processing component of this project along with providing on-site support during the flight mission. Mr. Lockwald will provide daily Q/A on-site of imagery to ensure quality imagery is collected throughout the entire project before the aircraft and street level collection vehicles leaves the project site

- Street level imagery collection Crew Member 2003-2004
- Field Data Collection Manager 2005 to Present

Lisa Turner - GEOSPAN Production Crew Manager

Education

Bachelor's Degree: Minnesota State, Mankato. 1997

G.I.S. Tech. Certificate: North Hennepin C.C. 2000

Highlights and Qualifications

Summer of 1997 internship, worked for the maintenance department at Crater Lake National Park, OR. Lisa gained GPS experience through surveying pullouts and other infrastructure using Trimble GPS units.

Work

2000-2006 Geospan Crew Member

Ms. Turner gained experience with all production functions through six years of consistently being a top-performing crewmember. Experience with property imagery cropping production processes including the last Calgary CPI project. Other experiences included surveying assets such as signs, manhole covers, inlets, water valves, fire hydrants, streetlights, and signals along with registering tax maps. Other duties included helping QA projects and training in new team members.

2007- Present Geospan Production Crew Manager

3. Ability to meet time and schedule requirements, at/or under budget.

The capacity and capability of the firm to perform the work in question with time limitations fixed for the completion of the project.

OPTIMAL is capable of performing $10,000,000 in work in a year and in the last 12 months have done over $7,000,000 in work for various customers. Our team offers a combined capacity of over 100 professionals with the ability to add additional capacity through existing relationships with surveying and mapping firms throughout the United States.

The OPTIMAL team has all the necessary personnel including management, with demonstrated experience and qualifications in all areas of surveying and mapping required and all necessary equipment to assure prompt response to and completion of all assignments on a year round basis. The Team has available resources to deploy acquisition and survey crews, fly aerial photography, perform other mapping tasks and other requirements to successfully deliver projects on time and within budget to the customer. OPTIMAL uses a project team concept for project organization. We have identified and reserved a production team dedicated exclusively to this contract that is fully equipped with the required resources and personnel resources to complete the project. Should it become necessary, OPTIMAL will be fully capable of exceeding delivery schedules. All personnel are highly trained, competent professionals in their respective fields.

Also, please keep in mind that OPTIMAL and its team members are able to increase capacity even more through the use of overtime as well as re-allocation of labor. Many of our employees are cross-trained and are able to work in multiple roles and departments.

4. Past performance, including costs, for similar projects.

General reputation of the firm and past record of performance with respect to such factors as control of cost, quality of work, and ability to meet schedules.

Various Customer Testimonials:

- On a recent task order completed on **2/28/2009** with the St. Louis District, U.S. Army COE we were ranked as "**EXCEPTIONAL**", and the following statement was given: "*Ft. Bliss says this was the best photography ever obtained over Ft Bliss.*"
- On a recent task order completed on **1/31/2009** with the St. Louis District we were ranked as "**EXCEPTIONAL**", and the following statement was given: "*Contractor worked well with Government to coordinate time lines and product requirements. Delivered a quality product. Worked with Government to accommodate for additional data...*"
- The Vicksburg District ranked us as "**OUTSTANDING**", and the following statement given: "*The contractor performed excellently while dealing with a **very large and complex project**, completing it **on time and within budget**.*"
- As a contractor to the Vicksburg District, we provided Mapping and Related Services under an indefinite delivery contract. We were awarded an **OUTSTANDING** rating. Remarks from the evaluation stated, "*The contractor's performance on this project was excellent given the **massive quantity of data***".
- In **January of 2009**, the Minnesota DOT rated Optimal Geomatics as follows on Project: SP 1926; TH316 for Photogrammetric Mapping Services: Our score was 34 out a possible 36 points on this $42,000.00 project. Contract period of performance was Dec. 15th, 2008 to June 30th, 2009. Project Name: "Hastings South to TH 6."

- On 9/22/08, OPTIMAL received an evaluation of a MSDOT project that was classified as: "*Frequently Exceeds, and Consistently Exceeds Expectations.*" MSDOT stated: *The Consultant often or always exceeds expectations for this category. The Consultant exceeds expectations repeatedly or everytime*.

- In January of 2007, the **Minnesota DOT** rated Optimal Geomatics as follows on Project: SP 7303-45; TH15 for Photogrammetric Mapping Services: *Our score was **35 out a possible 36 points** on this $98,000.00 project.* Contract period of performance was August 30, 2006 to December 20, 2006. Project Name: "Junction of I-94 to South Limit of Kimball, MN."

Project Manager Performance and Experience.

Our Project Manager, **Mr. Ronny Taylor** understands the critical role of communication and responsiveness in quality and schedule compliance for the project. His 33 year background and personal abilities give the management of the project a strong leader with the knowledge of how to best assess and design all project requirements, communicate and lead team members, and see objectives through to prompt completion.

We understand that the single most critical element to successful project management is effective communication. To this end, we pay particular attention to timely communication with our clients, partners and internal project team members. We take advantage of various technologies such as email, cellular phones, and internet to best advantage for collecting, directing, reporting and tracking information. The nature and circumstances surrounding a specific project or task will influence the types of tools to employ for effective execution. That said, we believe adherence to a system of management process and organization of operations is key to our project management success. Project information is organized in a consistent manner from project to project, maintained by the Project Manager in hardcopy form as well as on a central softcopy directory structure accessed by operations and administration staff.

5. References.

Project Name	MDOT SR-25 – Near Rankin County, MS / DOT Design Scale Mapping / #20539 / 10-040
Name and Address of Client	**Mississippi DOT (MDOT)** 401 North West Street Jackson, MS 39201
Client Contact Person **Current Phone Number** **Email Address:**	**Mr. Steve Lyle** (601) 359-7062 SLyle@mdot.state.ms.us
Period of Contract	**Jan. 2010 – May 31, 2010**

Background and Project Details:

This project is a transportation corridor design scale mapping project for the Mississippi Department of Transportation (MDOT). This is the fourth mapping project we have been contracted to produce directly for MDOT and the third to include a LiDAR component. This project will be acquired and mapped in conjunction with SR 18 (20538). This project is smaller in length than the last project but contains higher planimetric density. The general project vicinity is east of Jackson MS in Rankin County just north of I-20. As with SR-9, LiDAR will be flown in conjunction with photo in order to potentially reduce the extent of additional ground survey in obscured areas. The imagery flown will be at 1"=250' NCS equivalent resolution (1500' above mean terrain) with a Z/I DMC camera (RC&A). MDOT will supply survey services for panel establishment. Full control is planned to support 1"=50' scale horizontal accuracy and a 1' contour DTM. We will develop a 1' DTM and collect all visible planimetric data in accordance with the MDOT specifications and CADD Manual. Final products include design scale DTM, 1' contours, and planimetric data in DGN v8 format, a TIN in GeoPAK format, and color orthophotography with a 0.25' GSD. Product quality and timeliness of schedule was critical.

Area: 8.7 linear miles

Contract Amounts: $ 99,804.57

Project Manager: Mike Vessel, CP, GISP, RPP, SP

Project Name	Aerial Photography, Orthophotography, & AT / #20268
Name and Address of Client	**Rankin County Board of Supervisors** 211 E. Government Street, Ste A Brandon, MS 39042
Client Contact Person **Current Phone Number**	**Mr. Lance Cooper**, GIS Director or **Mr. Hardy Crunk** (601) 825-1470 (601) 825-9601
Period of Contract	**2008**

Project Details:

Deliverables included: Files in ARC/INFO; H-Datum in NAD83 and V-Datum NVD88; Ground control and targeting to support the requested project; Color aerial photography at negative contact scale of 1"=800' with 60% FOL and 30% sidelap; Digital photo index overlaying the County's sheet layout for the project area; Color digital orthophotos at .5' pixel resolution with 1"=100' scale accuracy; Image files clipped into individual files according to the County's sheet layout structure and naming schema; Digital orthos delivered in a format readable by ARC/INFO on external hard drive; Softcopy Aerotriangulation.

Area: 806 square miles

Contract Amounts: $ 191,599.00

Project Manager: Ronny Taylor

Project Name	Central Portion of County – Tuscaloosa, AL / Planimetric and Topographic Mapping, AP, Orthos, Aerotriangulation / #20529	
Name and Address of Client	**Tuscaloosa County Commission** 714 Greensboro Ave., #108 Tuscaloosa, AL 35406	
Client Contact Person **Current Phone Number** **Customer Website**	**Mr. Doster L. McMullen** (205) 349-3870 http://www.tuscco.com/	**Mr. Ronnie Kelley** (205) 349-3870 ext. 461
Period of Contract	2010	
Project Details Deliverables included: Aerial Triangulation Report; Updated Planimetric and Contour files (2' contours) in .dgn format; Color Aerial Photography, Color Digital Orthophotos tiled to the County's existing tiling scheme; files delivered in ARC/View TIFF/TFW format on external hard drive; Provided a MrSID mosaic of the new color digital ortho photography at a compression ratio of 40:1. **Area:** 358 square miles		
Contract Amounts: $ 375,187.00		
Project Manager: Ronny Taylor		

GEOSPAN

COOK COUNTY, IL	Summary
Solutions 360° Oblique Aerial and Street level Imagery Web and desktop software viewing enabled Property Data Validation	Cook County, Illinois, the second most populated County in the US awarded a multiple year contract for the collection of GEOVISTA® **Oblique Aerial Imagery** GEOVISTA® Oblique aerial imagery coverage was collected for the southern third of Cook County during spring of 2010 as the first phase of a three year project to coincide with the assessor's office reassessment priorities. GEOVISTA® Parcel Photo Libraries were delivered of downtown Chicago buildings. GEOVISTA® APIs will be used for ESRI suite of software integration along with the County's Motorola 9-1-1 system. Archive support of their current Pictometry imagery will be provided with this contract.
Reference Alan Hobscheid GIS Manager Department of GIS 69 W. Washington, 27th Floor Chicago, IL 60602 o: 312.603.1399 c: 312.519.9325 f: 312.603.9713 alan.hobscheid@cookcountyil.gov	Summary of other active contracts with Cook County: Property Imagery Update – GEOSPAN is collecting updated property imagery and attributes validation for 150,000 parcels. GEOSPAN had previously collected street level imagery for all properties in Cook County Transportation Department Asset Inventory –GEOSPAN collected 360º street-level GEOVISTA® imagery of all County maintained roads. GEOVISTA® Visual Surveyor software tools were used to build a complete inventory of County maintained traffic signs, pavement markings, traffic signals, bridges, raised reflectors, and curb lines in support of a major asset management project.

6. Geographic location of principle offices of the firm.

PRIME FIRM	SUBCONTRACTOR FIRM
Aeroquest Optimal, Inc. Mr. Mark Brooks Mark.brooks@optimalgeo.com 4975 Bradford Drive, Suite 100 Huntsville, AL 35805 Phone: (256) 882-7778 Fax: (256) 882-7774 info@optimalgeo.com www.aeroquestoptimal.com	**GEOSPAN Corporation** Mr. Steve Gilkey gilkey@geospan.com support@geospan.com 10900 73rd Avenue North, Suite 136 Minneapolis, Minnesota 55369 sales@geospan.com www.geospan.com 1-800-GEOSPAN

7. The estimated cost of completing the project expressed as a guaranteed maximum not to exceed amount. Project cost including development, deliverables and technical support.

The City of Branson is requesting proposals for three separate products (four, with optional LIDAR); that will constitute a single project in which to be proposed. Total area to be included in the digital orthophoto, oblique imagery, and topographic mapping project is a total of approximately 57 square miles. These areas are specifically delineated on the source map attached to this document.

1. **COLOR DIGITAL ORTHOPHOTOGRAPHY**, **4” pixel resolution**................................ **$39,638.00**

2. **DIGITAL TOPOGRAPHIC MAPPING, 2’**.. **$16,905.00**
   “in ESRI compatible format”

3. **OBLIQUE PHOTOGRAPHY** **$46,400.00**

4. **OPTIONAL LiDAR**.. **$39,746.00**

Included in Pricing:

5. **Trimble GEO XT GPS unit** and associated software.. **$8,108.00**
   (or equivalent equipment); that has the capability of capturing sub-foot accuracy data.

6. **Oblique Imagery Viewing Software** ....**$ NO ADDITIONAL CHARGE**
   Vendor to provide an unlimited seat license for a client based software program available for deployment to any city/county agency in the City of Branson and Taney County and to any municipality or public school within the City of Branson and Taney County. This software will allow the user to view and navigate on the oblique imagery and measure the distance, height, area, bearing, elevation, and roof pitch of features in the image. The image viewing software will have the capability to be used within the ESRI ArcGIS environment.

7. **Web Viewing Software** ***$5,800.00**
   *includes up to 10 hours of remote installation support

8. General description of how the project is to be complete.

The City of Branson is requesting proposals for three separate products (four, with optional LIDAR); that will constitute a single project in which to be proposed. The three main deliverables are 4” pixel resolution, color, digital orthophotography, 2’ digital topographic mapping in a vector, ESRI-compatible format, and oblique photography. LIDAR is an optional product, and is preferred if it lends itself to the development of either the topographic or orthophotos in a financially responsible manner.

General
OPTIMAL will produce all deliverables referenced to the Missouri State Plane Coordinate System, Central ZONE, NAD83 (horizontal), NAVD88 (vertical), US Survey Feet. OPTIMAL will utilize ground control points as well as airborne GPS and an inertial measurement unit as the controls for the City of Branson project. All control surveys will be performed utilizing OPTIMAL’s Topcon GR-3 GNSS receivers or OPTIMAL’s Leica AT502 GPS receivers. Where possible OPTIMAL will target existing National Geodetic Survey (NGS) survey monuments. During the photography missions, OPTIMAL will occupy one GPS ground station located in the project area. Further, OPTIMAL will utilize surrounding NGS CORS stations, via the APPLANIX MMS processing suite during the airborne GPS/IMU processing. During the LiDAR missions, OPTIMAL will occupy no less than two GPS ground stations.

Airborne GPS/IMU
OPTIMAL’s DMC II 230 camera includes an APPLANIX 510 inertial measurement unit (IMU) with integrated GPS/Glonass airborne GPS system. The IMU will provide direct georeferencing of the imagery and will act as the primary positioning and control for the project. Camera perspective centers will be accurate to within 0.05 m in X, Y, and Z. OPTIMAL has achieved this accuracy on previous projects. The IMU is able to calculate a more accurate position based on information collected by the systems gyroscopes and accelerometer. The IMU will also provide the orientation angles of the camera at the time of exposure. Our GPS antenna offset positions are accurately surveyed within a tolerance of 0.02 meters or better.

Reporting
At the conclusion of the project, OPTIMAL will submit a full ground survey report detailing the methodology and results of all survey activities

AERIAL PHOTOGRAPHY

Flight Time & Conditions
Photography flights shall typically be made between 10:00 AM and 2:00 PM, when the sun angle is not less than 30 degrees above the horizon. Photography shall not be done when the ground is obscured by snow, haze, fog or dust; when streams are not within their normal banks or when clouds or cloud shadows will appear in more than five percent of the area of any one photograph. LiDAR flights will be conducted during the best possible GPS times during each day.

Aircraft
All of our aircraft employ a Global Positioning System (GPS) augmented navigational system. Our flight planning data and specifications are ingested directly into this system resulting in acquisition of photography as close as physically possible to the planned coordinates. OPTIMAL will research any restricted flying areas and acquire all necessary permissions prior to flight. All operations will conform to applicable Federal Aviation Administration (FAA) regulations and ordinances.

Aerial Camera
OPTIMAL will utilize an Intergraph DMC II 203 digital camera for the collection of aerial imagery. The original DMC type certification from USGS is provided with this submittal.

Flight Plan
OPTIMAL has produced preliminary flightplans for the orthophotography and the acquisition. Today’s camera technology allows accurate photography to be flown at a significant higher altitude than past cameras. Utilizing the

DMC II 230, OPTIMAL proposes to fly at an altitude of **4,930** feet above the ground. This flight altitude will produce a raw GSD of **3.6** inches. Therefore, no up-sampling of the raw images will be performed for the production of the final 6-inch pixel orthophotography. Each flight line shall be flown continuously across the project area without interruption. OPTIMAL shall detail the number of flight lines, the spacing between successive exposures and the focal length of the camera used for each strip. OPTIMAL, at no additional cost to the City of Branson, shall correct unacceptable aerial photography. It is the responsibility of the contractor to ensure quality control compliance as set forth in this RFP. All re-flights shall be done within the time frame of this RFP.

Aerial photography shall have a forward lap of sixty percent (60%) and shall have a side lap of 30 percent (30%). Aerial photography will not have crab in excess of three degrees measured with respect to lines of flight. Tilt of the camera from vertical at the instant of exposure will not exceed three degrees nor will it exceed five degrees between successive exposure stations. Average tilt over the entire project area will not exceed one degree.

Softcopy or fully analytical aerial triangulation procedures will be used to check and densify the project control as needed to support base mapping meeting the project accuracy standards. The triangulation covering an area will be performed directly on the scale of aerial photography used to produce the mapping of the area without the use of control transfers from other photo scales. OPTIMAL proposes to use Intergraph ISAT aerial triangulation software to accomplish this task. Since we take a semi-automated approach using softcopy aerial triangulation, we have removed text from the specification in the RFP that would only be applicable to conventional approaches using fully manual aerial triangulation and/or hard copy photogrammetric processes.

The triangulation data for the project will be processed in a single “block” of images/photographs for the entire project area. If two scales of photography are flown, each will be processed as single blocks. The ISAT triangulation program has facility for consideration of airborne GPS/IMU as well as ground survey data, removing systematic errors, performing a rigorous block and bundle adjustment, and printing and outputting all measurements and/or calculations associated with the aerial triangulation process.

For the completed triangulation block, OPTIMAL will furnish as a deliverable a triangulation report containing a summary of the procedures and technologies used and results achieved and copies of triangulation input and output showing triangulation point weightings and residual errors and overall block RMSE. The triangulation report will include quality control checkpoint results and documentation of discarded control points. The report will be approved by an American Society of Photogrammetry and Remote Sensing (ASPRS) Certified Photogrammetrist.

OPTIMAL will collect LiDAR data to be used in the production of two-foot contours and as the DEM for the orthophotography. OPTIMAL has been providing LiDAR services since 1999. Our first system, which we have owned and operated since March 2000, is an Optech ALTM 1210. In 2004, we purchased an OPTECH ALTM 3100-DC LiDAR system. As LiDAR systems and projects have become more accepted and standardized, OPTIMAL has developed workflows and processes to ensure the quality of the final datasets exceed all required guidelines. OPTIMAL staff has performed many projects combining LiDAR and photogrammetry into single, cohesive products. Within our mapping workflow LiDAR has become the technology of choice in mass production of Digital Elevation Models (DEMs), Digital Terrain Models (DTMs), and Triangular Irregular Networks (TINs).
The accuracy standards to which OPTIMAL adheres to for all LiDAR data products are defined in FEMA’s Flood Hazard Mapping Program: Guidelines and Specifications for Flood Hazard Mapping Partners Appendix A: Guidance for Aerial Mapping and Surveying. These guidelines reference and specify both Federal Geographic Data Committee (FGDC) and the National Standard for Spatial Data Accuracy (NSSDA) standards. Additionally, OPTIMAL personnel are actively involved in the American Society for Photogrammetry and Remote Sensing’s (ASPRS) LiDAR Committee and have actively participated in the ASPRS LAS Format Working Group.

OPTIMAL’s two LiDAR sensors both contain first- and last-return capabilities. Additionally, the ALTM 3100 has the ability to discriminate a second and third return. DashMap, Optech’s LiDAR data post-processor is utilized in this task. DashMap utilizes the laser ranges, the scan angles, the GPS positions and inertial measurement information to accurately produce XYZ coordinates. Realm discriminates multiple returns by utilizing an energy threshold for individual returns and time differencing to delineate multiple returns. The energy threshold is different for each sensor and may change over time depending upon use and sensor age. The discrimination of multiple returns is based upon the spatial difference between objects and the speed of light. Typically, objects must be spaced one-to-two meters apart before distinct returns can be identified.

The TerraSolid suite of products is OPTIMAL's software of choice for LiDAR data classification. Additionally, OPTIMAL has written proprietary algorithms to assist in the classification of bare-earth terrain points, as well as vegetation and building points. These algorithms utilize the first- and last-return information to identify hard surfaces for building or terrain classification. Multiple returns from individual pulses are utilized to discriminate bare-earth ground from vegetation and above ground features such as powerlines.

The input for the production of the City's digital orthophotography will include the digital aerial imagery, the DEM produced from LiDAR, the control/aerial triangulation information, and the calibration data for the project aerial camera. This data will be combined to georeference the digital imagery and remove relief displacement in a pixel-based rectification process.

OPTIMAL applies **Intergraph Base Rectifier** and **OrthoPro** software as the basis for our orthophoto production process. The imagery will be differentially rectified using a cubic convolution algorithm. Prior to application in the rectification process, the TTN will be developed from the DTM. The TTN will be output to an appropriately spaced regular grid pattern for ingestion in the rectification software. The neat area of every image will be used in the production process. Special care will be taken around overpasses and bridges to ensure that surface imagery is not displaced. If smears result around features where vertical elevation differences are minimal, imagery from adjacent photographs will be used to patch the smear where practical.

Scale/Resolution/Coverage

All orthophotography will be produced to comply with accuracy standards given in *Reference Guide Outline – Specifications for Aerial Surveys and Mapping by Photogrammetric Methods for Highways* developed by the American Society of Photogrammetry for the US Federal Highway Administration in 1968. Orthophotography will meet this accuracy standard at the 1"=100' scale and will be comprised of 0.5' pixels. Full image tiles will be produced to cover the project area peripheries. Resampling of the imagery to the target pixel resolutions will be accomplished using a cubic convolution algorithm. The imagery used in the rectification and resampled to the specified pixel resolutions will initially have pixel resolutions that are finer than the specified resolutions. As previously stated, no resampling from coarser to finer resolutions is will be done.

In the orthophoto production process, image brightness/radiometry will be represented by 8-bit, 256 levels (0-255) for each of red, green, and blue bands, with uniformly varying color shades. The imagery shall be orthorectified using Intergraph Base Rectifier, providing a three-dimensional photogrammetric space resection equation giving reliable positional and relative accuracy of features depicted on the image across the entire City. The rectified images shall be tone/color and contrast balanced and mosaicked/edge-matched to adjacent images using automated and/or manual image processing techniques. The processes will select optimal (central) portions of the rectified images and combine these into a "seamless" image representation, with no apparent edges or breaks in tone/color or feature geometry.

Localized adjustment of the brightness values shall be performed as required to minimize tonal differences between the join areas. For this adjustment, the orthophoto judged by visual inspection to have the better contrast shall be used as the reference orthophoto. Localized brightness values of the adjacent orthophoto shall be adjusted to the reference orthophoto. When feasible, the area adjusted should be bounded by a tonal-break feature such as a road, field line, shadow line, etc. The radiometric adjustment shall not compromise the accuracy, clarity or resolution of the orthophotography. The orthophotography shall be free from defects and inconsistencies within and across the individual rectified images.

OPTIMAL can propose to the City a tile format following a modular layout.

All bridges/overpasses and underlying features shall retain their correct ground location and geometry in the digital orthophotography. The project will not involve the development of "true" orthophotography (i.e., all vertical feature displacement/lean removed) for the project area. Measures will be taken, however, to minimize the degree of lean in relation to ground features being obscured and minimize anomalies resulting from differences in feature lean across seam lines. These measures will include utilizing only the central portion of each photograph for the final orthophoto output and ensuring that seam lines between images follow linear features and do not pass through elevated structures, particularly buildings.

Throughout the orthophoto production process, OPTIMAL will apply appropriate Quality Control checks to ensure a resulting end product that meets both geospatial accuracy criteria and maintains the necessary image quality required to meet the application needs of the City. As the rectification and image processing is completed, the orthophoto images shall be subject to thorough manual quality control inspection with the following acceptance criteria being observed:

- Geometric accuracy of images meeting project standards
- No distortion of ground features (e.g., roads, railroads, bridges/overpasses, buildings) by inadequate rectification, including warping of roads/railroads/bridges & excessive or mismatched building lean
- No “gaps” in imagery or missing imagery at area peripheries
- No significant scratches, dust, lint, compression artifacts, stretching, blurring, or other image anomalies. Rectified image quality will be equal or better than the original aerial negatives
- Feature edge and tone match within specified tolerances
- Consistent image radiometry (referenced to radiometry agreed to upon acceptance of the Pilot Area.)

OPTIMAL will provide digital 2’ contours based upon the LiDAR data. The contours will represent the shape of the terrain within the project accuracy standards, and will clearly depict all drainage, road crowns, stream banks, and other areas of terrain change. A TIN-based program capable of separate processing of mass point, breakline, and skeletal line data shall be used for the contour generation. The contour vectors will be produced in continuous, topological form with elevation attributes assigned. The 10’ interval lines will be attributed as “index” contours while the balance of the contour lines will be attributed as “intermediate” contour lines. Contour lines shall be split as they transition from an obscured area to a non-obscured area and should be attributed separately so as to indicate their approximate nature. No void areas will be output. All contour lines shall be continuous.

OPTIMAL through GEOSPAN proposes the GEOVISTA® ultra-high resolution 21 mega pixel cameras for this project. This higher camera resolution supports providing larger image footprints from both proposed flying heights.

Low Altitude Oblique Aerial Specifications					
Camera	**Angle**	**Resolution**	**Frontline pixel size**	**Midline pixel size**	**Backline pixel size**
Front	42º Oblique View	5616x3744	>4”	4.7”	<6”
Back	42º Oblique View	5616x3744	>4”	4.7”	<6”
Left	42º Oblique View	5616x3744	>4”	4.7”	<6”
Right	42º Oblique View	5616x3744	>4”	4.7”	<6”
Down	90°Vertical View	5616x3744	4.56”	4.56”	4.56”

High Altitude Oblique Aerial Specifications					
Camera	**Angle**	**Resolution**	**Frontline pixel size**	**Midline pixel size**	**Backline pixel size**
Front	42º Oblique View	5616x3744	>9.81”	12”	<16.82”
Back	42º Oblique View	5616x3744	>9.81”	12”	<16.82”
Left	42º Oblique View	5616x3744	>9.81”	12”	<16.82”
Right	42º Oblique View	5616x3744	>9.81”	12”	<16.82”
Down	90°Vertical View	5616x3744	12”	12”	<16.82”

Aeroquest Optimal, Inc. is located in Huntsville, AL and is registered in the state of Delaware. GEOSPAN is located in Minneapolis, MN. All imagery will be processed in the U.S.

Oblique Imagery Viewing Software

GEOVISTA® Oblique View Parcel Library -We propose an optional library of GEOVISTA® Oblique Property Views for every property. Please see Page 24 through 26 for details regarding how this innovative automated approach is used to build a very valuable JPEG property imagery inventory that will import right into your CAMA System along with serving all other needs for property photos. The advantage of these property views is instant recall of the best five views of every property without the need of a GIS.

Flexible licensing terms – GEOSPAN provides flexible licensing terms to put our clients back in control of data ownership.**The County will own the GEOVISTA Imagery with no restrictions.**

The **GEOVISTA®API** includes the ability to catalog, organize, and retrieve oblique and orthogonal imagery easily and efficiently.

The GEOVISTA®API includes the ability to retrieve imagery via address search, Tax Parcel or ID search and Coordinate search when configured to integrate with a mapping system

The GEOVISTA®API includes the ability necessary to process on screen measurements.

The GEOVISTA®API provides the ability to determine the x, y and z coordinates of each pixel using both the ortho images and the oblique images, users are able to measure on screen the width, length, area, and height (oblique only) of any feature on the image.

The GEOVISTA®API provides a digital information system capable of retrieving, displaying, and calculating required information relating to the photography and other data systems.

The GEOVISTA®API will handle multiple image catalogs simultaneously and be able to simultaneously compare and contrast both nadir and oblique images of the same location captured at different times.

A version of the GEOVISTA®API configured with an embedded TatukGIS mapping system provides a georeferenced location map which will allow the user to click on it and have the images for that area appear on the screen.

GEOVISTA® imagery utilizes a JPEG file format with approximately 50% compression. We typically place the GEOVISTA imagery in GEOVISTA® Video Index (GVI) containers, which is a modified AVI file format to provide an efficient way to copy large quantities of images across a network along with "on the fly" decompression to maximize storage space.

The GEOVISTA® Video Index (GVI) supports image tiling so that only the subset of the image bounded by user selected zoom extent level is accessed to provide fast and efficient viewing of GEOVISTA images.

The GEOVISTA® Video Index (GVI) supports synchronized oblique archive viewing

The GEOVISTA API supports converting UTM, State Plane, and Lat/Lon coordinate systems on the fly.

The GEOVISTA API supports overlaying and displaying data in the various coordinate systems without the need to re-project the data multiple times.

Application Architecture

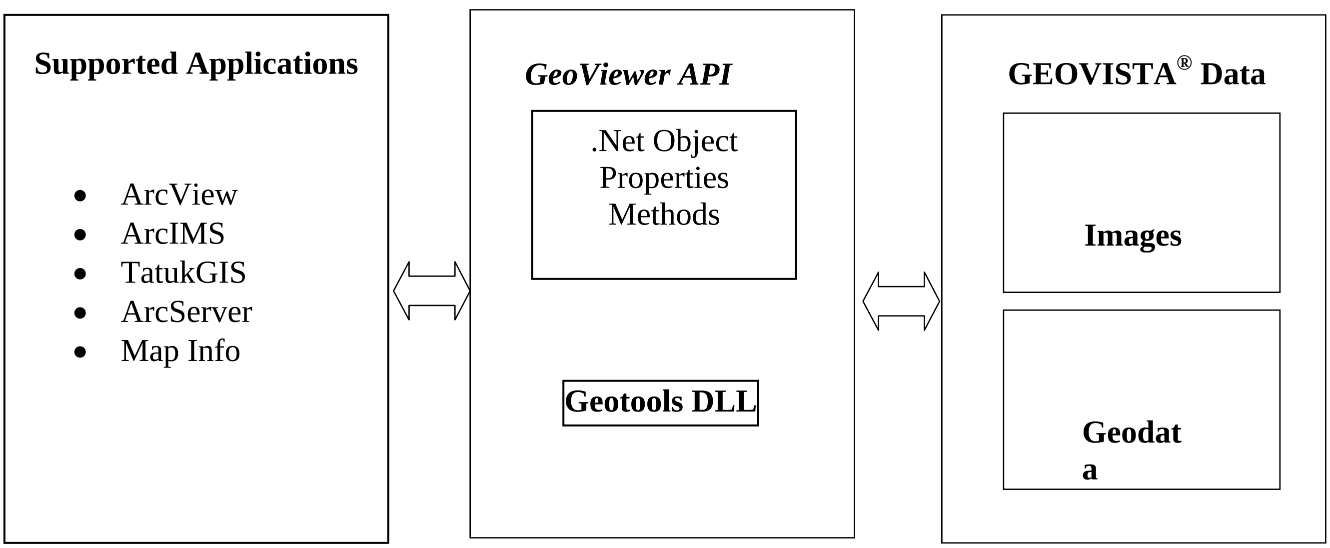
All access to **GEOVISTA®** images and data is through the GEOVISTA® Application Program Interface (API), that can be embedded within existing GIS applications. This .NET object provides system functionality via a consistent and published interface as documented in the GEOVISTA® API Reference.

The following programming languages and environments were used during development of the proposed system.

- Microsoft C# using Visual Studio .NET 2003
- Microsoft C++ 6.0 using Developer Studio
- Microsoft Visual Basic 6.0 using the VB development environment
- Database access using Microsoft ADO and ADO.NET

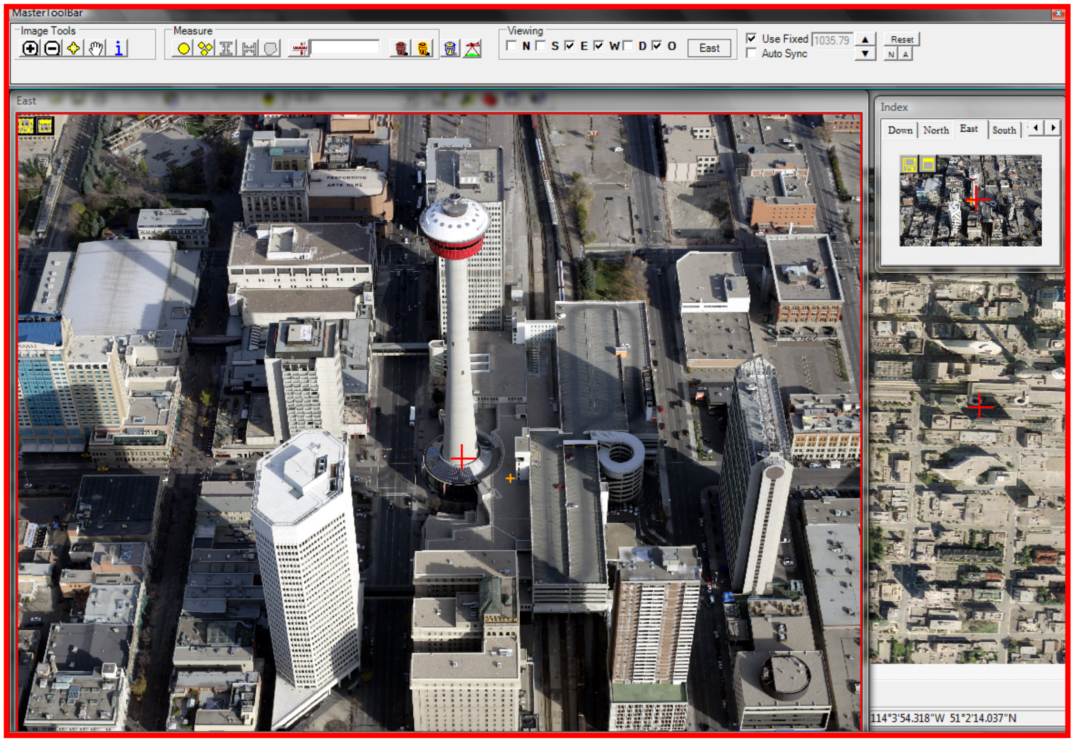
The **GEOVISTA**®API is designed to accommodate the following viewing options:

- Stand alone application software for the performance of browsing and analysis operations. The GEOVISTA® Oblique Imagery Viewer includes an embedded map engine to serve the needs of the “stand alone” application user needs.
- A desktop-based solution that integrates oblique imagery browsing and analysis capabilities with ESRI ArcGIS Desktop products
- A web-based solution that works in conjunction with ESRI Server products



The **GeoViewer** object responds to Windows events, such as mouse clicks and keystrokes, and raises its own events that can be handled by the host application within which it is embedded. Additionally, documented properties and methods of the GeoViewer object are exposed to and may be accessed at any time by the host application.

Example of Property Information Portal developed with the GEOVISTA® API



Example Web Browser Functionality:

- Property imagery retrieval by Property ID# or Address
- Select thumbnail image to display in viewer window
- Supports integrated GEOVISTA® street level views
- Ability to pan and zoom within image
- Ability to "fly" to next image in any direction

OPTIMAL through subcontractor GEOSPAN proposes the GEOVISTA® ultra-high resolution 21 mega pixel cameras for this project. This higher camera resolution supports providing larger image footprints from both proposed flying heights.

Delivery Schedule:

The City expects a timely product delivery. This final schedule will be discussed with the selected firm. A proposed delivery schedule shall be included in the proposal.

Task	Date
Contract Award	February 15, 2011 *(approximate)*
Kick-off Meetings with Internal Staff and Team Members	February 18, 2011
Ground Control Recovery and Placement	February 28, 2011 - March 11, 2011
Color Vertical Aerial Imagery Collection	March 23, 2011 - March 31, 2011 *(dictated by occurrence of optimal weather conditions)*
Aerial Imagery Processing & Quality Check	March 25, 2011 - April 6, 2011
Color Oblique Imagery Collection	March 23, 2011 - March 31, 2011 (dictated by occurrence of optimal weather conditions)
Oblique Imagery Processing & Quality Check	March 25, 2011 - April 6, 2011
LiDAR Data Acquisition	March 23, 2011 - March 31, 2011 *(dictated by occurrence of optimal weather conditions)*
LiDAR Data Processing & Quality Check	April 1, 2011 - April 15, 2011
LiDAR Data Classification to bare-earth	April 15, 2011 -- May 25, 2011
Collect Breaklines to support generation of 2' Contours	May 23, 2011 – June 15, 2011
Aerial Triangulation	April 7, 2011 - April 21, 2011
Orthophoto Production using bare – earth LiDAR surface	May 20, 2011 - June 30, 2011
Oblique Imagery Production	May 20, 2011 - June 30, 2011
Generate 2' Contours from bare-earth Surface and Breaklines	June 16, 2011 - July 6, 2011
Deliver Oblique Imagery and Viewing Software	July 11, 2011
Deliver Color Digital Orthophotos	July 15, 2011
Deliver 2 foot Contours	July 15, 2011
Deliver GPS Unit and associated Software	July 15, 2011

KUCERA INTERNATIONAL INC.

PHOTOGRAMMETRISTS • GEOMATIC PROFESSIONALS • ENGINEERS

Corporate Headquarters
January 27, 2011

Curtis J. Copeland, G.I.S. Coordinator
City of Branson
110 W. Maddux Street, Suite 310
Branson, MO 65616

Re: Proposal for 2011 Aerial Mapping Project

Dear Mr. Copeland:

Kucera International Inc. is pleased to offer the following proposal for City of Branson's 2011 digital aerial orthophotography, oblique aerial imagery, lidar capture and other services as the development of new 2' contours and the update of existing DTM and contours as described in the City's RFP dated January 6, 2011 and associated correspondence.

In accordance with the City's evaluation criteria, this proposal submission includes experience and capabilities, project team, completion schedule, references, geographic location, cost schedule, and proposed approach.

Kucera International Inc. specializes in the work being sought and stands as one of the largest, most experienced, most advanced, and most stable companies in the aerial mapping services profession. Kucera is currently in its 57th year of providing aerial photography, surveying, topographic mapping, and other associated photogrammetric services, and has been providing orthophotography, digital elevation/terrain modeling, digital planimetric/topographic mapping, and digital cadastral mapping in-house for over 20 years and lidar capture for over the past 10 years and oblique image capture for the past three years. Over the past decade, Kucera has successfully completed these services for over 200 counties, cities and other large areas throughout the country, including several cities and counties in the State of Missouri.

All of the work for this contract including any required ground surveys, lidar and digital image capture will be accomplished with equipment owned and operated by Kucera. The reduction of the lidar, image processing, development of new contours, and updating of existing contours along with other associated photogrammetric processes will be accomplished at Kucera's 18,000 square-foot corporate headquarters office in Willoughby, Ohio (houses over 50 digital photogrammetric data processing/mapping and GIS/CAD stations running multiple current version licenses of all major aerotriangulation, ortho generation, digital mapping and GIS/CAD platforms. At this facility Kucera has a staff of over 60 mapping professionals with an average experience level of over 15 years available for commitment to the project.

Kucera's 120,000 sq. foot hanger located at Lost Nation Airport in Willoughby, Ohio serves as a base of operations for its six aircraft (four twin-engine and two single engine) outfitted with latest generation navigational aerial sensing and airborne GPS/IMU control surveying systems.

Kucera will accomplish the oblique aerial imaging work with the assistance of subconsultant Geospan Corporation of Minneapolis, Minnesota. Kucera will acquire the oblique imagery using Geospan's eight camera digital aerial oblique imaging system operated from Kucera's turbo charged single engine aircraft. The oblique image processing and dataset preparation will be accomplished by Geospan. Geospan has performed oblique aerial imaging services for many counties and cities throughout the US and Canada, including a number of counties/cities in conjunction with Kucera in 2009 and 2010.

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38133 Western Parkway
Willoughby, OH 44094-7589
(440) 975-4230
Fax (440) 975-4238
map@kucerainternational.com

Henderson Aerial Surveys
3889 Grove City Road
Grove City, OH 43123-9193
(614) 539-3925
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Keddal Aerial Mapping
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Pittsburgh, PA 15241-3955
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Kucera South
110 W. Reynolds Street
Suite 202
Plant City, FL 33563-3379
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Fax (813) 754-9830
l.towles@kucerasouth.com

Kucera Southeast
PO Box 2886
Bluffton, SC 29909
(843) 705-2592
Cell (843) 540-2157
r.mangus@kucerainternational.com

Kucera's approach to the City of Branson project will feature the most advanced and efficient in geospatial data acquisition and processing technologies and procedures combined with thorough manual quality control testing, review, and edit. Kucera's twin-engine aircraft have two sensor ports, allowing for simultaneous acquisition of vertical and oblique aerial imagery and/or Leica ALS60 lidar data capture from one aircraft in one mobilization. The vertical aerial imagery used for orthophoto production will be acquired using Kucera's latest generation Vexcel UCX large format digital frame camera system. *Any lidar that may be required will be collected using Kucera's Leica ALS60 lidar system. The ALS60 uses Multiple Pulse in the Air (MPIA) which in effects doubles pulse densities. The oblique aerial imagery will be captured with an advanced GeoVista eight-camera digital aerial oblique imaging system. All of the aerial camera systems used have integrated first order airborne GPS/IMU systems for accurate in-flight georeferencing of the captured imagery. The georeferencing will be checked against targeted ground control and refined as needed through a rigorous softcopy aerotriangulation process. Kucera's first order BAE Socet Set and Cardinal Systems VR2 softcopy stereoplotters will be used to update the City's DTM and to stereocompile collected vertical breaklines to supplement its existing lidar data in full photogrammetric fashion. The rectification of the aerial oblique imagery will be directly to the airborne GPS/IMU with incorporation of the City's DTM for refinement as needed. The oblique imagery will be furnished with robust viewing/application software compatible with the City's CAD/GIS and E911 systems. For the digital orthophoto production, the georeferenced aerial imagery will be automatically rectified and tone balanced/mosaicked/tiled into a seamless image representation with each of these stages followed by a thorough manual inspection and edit on dedicated image processing stations. The updated topographic and planimetric feature mapping will similarly be batch and manually processed to seamless data coverages and will be checked for consistency with the corresponding digital orthophotography. All mapping will be rigorously processed to and quality control checked in the designated CAD/GIS environments.

***Kucera while in the process of collecting lidar over Greene County, Missouri and its immediate surroundings captured lidar data covering the 57 sq. mile City of Branson area. this lidar which averaged two pluses per 53 meters is sufficient for the development of 2' contours. This data will be available for this project at the cost to classify and reduce to a bare earth DTM.**

Kucera will accomplish the optional oblique aerial imaging work with the assistance of subconsultant Geospan Corporation of Minneapolis, Minnesota. Kucera will acquire the oblique imagery using Geospan's digital aerial oblique imaging system operated from Kucera's aircraft. The oblique image processing and dataset preparation will be accomplished by Geospan. Geospan has performed oblique aerial imaging services for numerous counties and cities throughout the US and Canada, including four counties/cities in conjunction with Kucera in 2010.
Kucera is committed to completing the Henrico County contract work in a timely fashion while maintaining the highest level of product quality. The work will be rigorously managed throughout its duration by a team of experienced geomatics professionals, all of whom have had management/supervisory positions on multiple similar countywide base mapping contracts. These individuals will coordinate closely on the project and exercise strict production and quality management through a computerized job tracking/reporting system and contract-specific quality control plan.

As Kucera's Project Manager and primary point of contact, I will be dedicated to ensuring that all aspects of Kucera's service on this project will be fully satisfactory to the County. I and the other members of Kucera's management team will be available at all times to report to and/or consult with the County.

Kucera appreciates being considered for this project and looks forward to serving Henrico County. Please contact me as needed.

Sincerely,

John W. Antalovich Sr.
CEO

Firm Name and Address Place of Performance:	GeospanCorporation 10900 73rd Avenue North Suite 136 Maple Grove, Minnesota 55369 Phone: 763-493-9320 Fax: 763-424-6633
Year Firm Established:	1990
Type of Ownership:	Privately held corporation
Background, Longevity, Financial Stability:	Geospan is an advanced photogrammetric industry provider of the highest resolution, most accurate, multi-angle oblique aerial and integrated 360° street-level imagery available. GEOSPAN is a company with unique intellectual assets in the science of visual geospatial information. The company has invested more than $12 million in the research and development of patented technology that enables the creation of computerized three-dimensional models from standard two-dimensional cameras.

COMPANY PROFILE

Firm Name and Address:	Kucera International Inc. 38133 Western Parkway Willoughby, OH 44094 Phone: 440-975-4230 Fax: 440-975-4238 Email: map@kucerainternational.com Website: www.kucerainternational.com
Year Established:	Established 1953. Incorporated in 1956. Name changed from Kucera & Associates Inc. to Kucera International Inc. in 1985.
Ownership/Business Status: ***Federal Tax No.:***	Kucera is a privately held, Ohio corporation with no parent. 34-0808463
Licensing:	Kucera is licensed to conduct business in the State of Virginia
Similar Service Revenue/ No. of Projects:	2007 - $10 million – 170 projects 2008 - $8 million – 195 projects 2009 - $7.8 million – 135 projects
Longevity and Financial Stability:	Kucera's overall business strategy has historically and continues to be one of steady, manageable growth founded on a core expertise in aerial photogrammetry with controlled expansion into related areas, e.g., GPS surveying, cadastral mapping, facilities management, data conversion, remote sensing, and GIS support. This strategy has enabled Kucera to remain as one of the most stable and financially sound companies in the mapping profession and operate as the same privately held corporation for over 50 years. Over its history the company has experienced steady growth at an average rate of 10 to 15% annually and has always kept its growth within its capacity to perform. Kucera has never failed to complete a contract and has consistently maintained high financial ratings and low employee turnover. Kucera's staff is a primary source of its stability, with an average employee tenure of over 15 years. Kucera operates under a written succession/ continuation plan, and currently stands as one of the largest, most advanced, and most respected companies in its field, with annual sales of over $10 million and an annual technology investment of over $1,000,000. Kucera has a current asset-to-liability ratio of 2:1 and a $2 million line of credit with PNC Bank. Kucera has been a multi-year recipient of the Lake-Geauga Fast Track 50 award for the 50 best performing companies in the northeastern Ohio region.

COST AND COMPLETION SCHEDULE

Cost Schedule:

Item/Phase	Fee
1. Project initiation	$2,000
2. Ground control survey/targeting	3,000
3. Aerial lidar survey	no charge
5. Aerial lidar classified data reduction	3,000
6. Aerotriangulation	2,000
7. Color digital orthophotography, 0.5' pixel	3,000
8. Oblique imagery	45,000
9. New contours and updates	26,350
Total	79,350

Completion Schedule:

Kucera's proposed completion schedule for the 2011 City of Branson project by phase is as follows, assuming a contract start date of approximately February 12, 2011.

Phase	*Start*	*Complete*
Project initiation	2/13/11	2/19/11
Ground control survey/targeting	2/20/11	2/28//11
Aerial image acquisition (vertical and oblique)	3/1/11	3/31/11
Aerial data initial processing/georeferencing and inspection	4/1/11	4/9/11
Oblique aerial image rectification	4/10/11	4/30/11
Oblique image delivery, application program installation, training	5/1/11	5/15/11
Aerotriangulation	4/1/11	4/19/11
Pilot Project	4/10/11	4/16/11
Orthophoto Production	4/16/11	8/15/11
Update stereocompilation	4/10/11	5/15/11
Updated topographic map production	5/15/11	6/15/11
Project wrap-up/metadata delivery	6/15/11	6/30/11

All project work will be completed and delivered to meet schedule requirements.

PROJECT OVERVIEW

Statement of Work:

The primary services and associated data products Kucera International Inc. will furnish to the City of Branson, Missouri for this contract will include new (winter/spring 2011) digital vertical and oblique aerial photography, ground and airborne control surveying, georeferenced color 6" resolution digital oblique aerial imagery, oblique viewing/application software and training, vertical image aerotriangulation, color digital orthophotography at 1"=100' scale, 0.5' resolution, change detection, digital terrain model (DTM) stereocompilation or vertical breaklines to support lidar data, and new and updated 1"=100' scale, 2' contour topographic feature mapping covering the City. For the development of new and updated contours Kucera will utilize ASL60 lidar data recently acquired (January 19, 2011) while Kucera was collection lidar data of Greene County, Missouri.

Primary features of Kucera's approach to the project work are as follows:

- Kucera will accomplish citywide vertical aerial imagery with a large format digital frame camera (Vexcel UCX).
- Kucera will utilize ALS60 lidar data captured on January 19, 2011 for the development of the ortho DEM and new contours and the updating of existing contours. The average vertical pluses for this project will be 2 points/meter.
- Kucera will locate and target existing ground in sufficient number to meet the required specifications.
- The digital oblique imagery will be captured with an advanced GeoVista aerial oblique imaging system, consisting of eight 21 megapixel digital cameras integrated with a common airborne GPS/IMU system.
- Both a vertical and oblique camera system will be operated from one of Kucera's twin-engine aircraft which has dual sensor ports, this avoiding a separate aircraft mobilization and increasing flyover efficiency, consistency, and cost-effectiveness.
- All of Kucera or Geospan's equipment has been calibrated and those that can be certified by US Government agencies have been done.
- The oblique imagery and all other data deliverables will be owned by the City, unless otherwise desired by the City. The oblique image delivery will include full viewing/application software along with installation and training at the City's office.
- The plan/topo update work will be performed in full photogrammetric fashion on Kucera's softcopy stereoplotters using the triangulated stereo version of the vertical aerial imagery. No 2D "heads-up" updating will be performed.

Project Standards and Accuracies:

All project work will be performed in accordance with the City's aerial imaging and mapping services RFP 10-8912-8CS Scope of Services, including conformance with ASPRS Class 1 Large Scale Map Accuracy Standards and US National Map Accuracy Standards as designated for the dataset deliverables. The accuracies which will be met for the various deliverables in terms of image/map represented positions and/or elevations for well-defined ground features in relation to their "true" (accurately surveyed) positions and/or elevations are as follows:

Project Dataset	**Accuracy**
1"=100' scale digital orthophotography	within 1' RMSE and within 3'/individual point horizontal (ASPRS) Class 1)
1"=100' scale updated planimetry	within 1' RMSE and within 3'/individual point horizontal (ASPRS Class 1)
New and updated DTM/2' contour topography	within 1/3' RMS and within 1'/individual point vertically (ASPRS Class 1)
aerial oblique imagery	within 2m absolute horizontal and 1m absolute vertical at 90% confidence. Relative vertical accuracy within 0.5'

Conformance with the project accuracy standards will be internally verified through review of aerotriangulation results and comparison of image/map coordinates for targeted-surveyed control and photo identifiable triangulation points against their corresponding field/GPS-surveyed and computed values. Accuracy tests of each dataset will be performed using at least 10 points spread through the City and documentation of results included in project metadata.

Note that the accuracy criteria do not apply to structure top locations represented in the orthophotography and oblique imagery due to inherent radial distortion/"feature lean" effect, although Kucera uses technologies and processes as subsequently described which reduce this effect. Note also that the accuracy requirements do not necessarily apply to any unchanged existing planimetric/topographic feature mapping.

Project Datums/Units:

The datums used for the capture/measurement and delivery of the project data will be the NAD 83/HARN VA State Plane horizontal and NAVD88 vertical datums as specified. The unit of measurement will be the US survey foot.

County Support:

The support Kucera would ask of the City other than designating persons of contact would include:

- Designating pilot area(s) and reviewing/approving pilot area deliverables.
- Timely review of deliverables to ensure that all data listed in the transmittal is received and no data is missing, corrupted, improperly formatted, etc.
- Providing any source needed available for the project work (e.g., existing DTM and planimetrics) and assistance in answering any general questions regarding the source materials
- Consistent and thorough QC review of data submissions

In relation to all of the above, Kucera will work cooperatively with the City and adjust processes as required to best accommodate the County's support capabilities.

Approach:

In order to complete the work in a timely, organized, and cost-effective manner while maintaining a high level of quality and accuracy, Kucera will utilize a systematic, phased approach incorporating the most advanced available, proven photogrammetric, control surveying, and aerial imaging technologies and procedures. The major phases in general order of performance will be as follows:

1. **Project Initiation** – Finalize scope of work and document in project plan. Review and organize project source data.

2. **Ground Control Surveying/Targeting** – Select, recover or establish, and target ground-based control points throughout the project area for use in georeferencing/ aerotriangulation of the vertical aerial imagery and accuracy testing/quality control of the georeferenced datasets.

3. **Aerial Photography/Airborne GPS-IMU Survey** – Perform aerial flyover/photography of the project area using vertical and oblique digital aerial cameras interfaced with airborne GPS/IMU systems. Process and check the aerial imagery and airborne GPS/IMU results.

4. **Oblique Imagery Delivery** – process/rectify oblique aerial imagery and deliver together with viewing/application software. Provide training in viewing/application program use.

5. **Aerotriangulation** – Use a softcopy aerotriangulation process with ground and airborne GPS/IMU control survey input to check and finalize the georeferencing of the vertical aerial imagery.

6. **Pilot Project** – Produce final orthophotography and updated topographic/planimetric feature mapping covering designated pilot area for County review and procedure/deliverable verification.

7. **Update Stereocompilation** – Photogrammetrically review/update the County's existing planimetric feature mapping and DTM, with the updated DTM being used for ortho image rectification and updated 2' contour topo generation. Use automated change detection to help identify areas of change.

8. **Digital Orthophoto Production** – Orient triangulated digital photo imagery and ortho rectify to reviewed/updated project DTM. Batch and manually process rectified imagery into final orthophotography.

9. **Topographic/Planimetric Feature Mapping** – Generate contour topography from updated DTM and batch and manually edit together with updated planimetric feature mapping. Convert to ESRI/ArcGIS format.

10. **Project Wrap-Up/Report/Metadata** – Review project specifications and transmittal/deliverable records to ensure all specified data has been received and approved. Provide FGDC metadata for each dataset.

The lidar for this project has been captured on January 19, 2011 if Kucera is awarded the contract it will provide to the City at Kucera's cost to reduce, classify, and reduce to a ortho DEM.

The work phases will be performed concurrently to the maximum extent possible to maximize efficiency and accelerate turnaround/completion times.

PROJECT TEAM

Kucera's project management team and corresponding project assignment, experience, and time commitment to this contract are as follows:

Assignment	Name/Title	Years of Experience	Weekly Time Commitment (Hours)
Project Manager	Ronald L. Martin, ASPRS CP Chief Photogrammetrist	44	24
Chief Administrator	John Antalovich, Jr., PE, PS President	30	16
Ground Survey Operations Manager	Bill Loetz, OH PS Ground Survey Manager	24	40
Flight Operations Manager	Gary Cox Chief Pilot	35	40
Aerial Photo/Sensor Operations Manager	David Cook Chief Aerial Camera/Sensor Operator	36	40
Lidar Processing Manager	Nat Phillips LiDAR System Manager	18	40
Oblique Image Manager	Jim Jenkins Oblique Image Manager	22	40
Airborne GPS/IMU and Aerotriangulation Manager	Matt Albring ADS40 Georeferencing Manager	22	40
Stereocompilation Manager	Eric Baker Chief Stereocompiler	12	40
Orthophoto Production Manager	Bill Scott Orthophoto Rectification Manager	25	40
Digital Image Processing Manager	Dan Debiase Image Processing/Computer Systems Manager	19	40
CAD/Edit Manager	Paul Bishop Vector Edit Manager	21	40
GIS/Data Conversion Manager	Stanley Wong, GISP GIS Manager	15	24
Quality Control Manager	Scott Antalovich, PE, PS Vice President	26	24

Kucera's project management team offers a wealth of practical experience and includes individuals licensed/certified in surveying, mapping, photogrammetry, and engineering. All project management team members have previously held supervisory roles on numerous similar multi-city/county base mapping projects.

The Project Manager and all other members of Kucera's management team will be assigned to the Branson contract work throughout the contract duration. There will be no rotation/replacement of project team members over the course of the contract unless required by a team member becoming incapacitated or no longer employed by the company. In this case, an equally qualified individual is assigned and the client is immediately notified and requested to approve the replacement. The rotation/replacement request will include the reason for the rotation/replacement, the qualifications of the replacement team member, and the commitments of the replacement team member. A meeting of the replacement team member with relevant client representatives will be scheduled as required for approval.

Management Process:

Throughout the contract period the designated Project Manager serves as the primary point of contact responsible for reporting to the client and overall coordination of the project work.

On a weekly basis throughout the contract period the Project Manager will meet with relevant members of the management team to review the scope of work/work completed, upcoming project assignments, delivery milestones/completion status, actual vs. estimated costs, quality control procedures and results, client feedback, and other relevant contract information.

As part of the contract initiation phase and before commencing any project work, the Project Manager prepares a comprehensive job write-up/work plan detailing the project specifications, schedule milestones, designated technologies and procedures, management team member/departmental assignments, and the project critical path network. The work plan is distributed to and reviewed with each member of the project management team through a computerized job database accessible to all team members through a companywide intranet. As the project goes through the production process, the status will be updated at least weekly by the relevant project management team members in the master job database. The Project Manager and members of the management team will review the status and schedule through the database and plan for work accordingly. A master job file is also prepared containing all relevant project materials and maintained in a central storage area with circulation between departments as required.

Throughout the course of the contract the Project Manager will closely monitor/track the individual work phases and completion schedule. The Project Manager will continually emphasize to the key project personnel that the schedule must be maintained and that every effort should be made to complete the work on a particular phase ahead of schedule. The Microsoft Project Manager program is used to develop and monitor the project critical path. When work on a particular phase is completed ahead of schedule, the work on the subsequent phase will be started immediately in order to accelerate deliveries and allow greater flexibility in maintaining the overall schedule. The various production phases will also be performed concurrently to the fullest extent possible in order to maximize production effectiveness and efficiency. The individual work phases are completed in logical segments or blocks defined by the client's priorities and/or optimal procedural efficiency so as to allow for a simultaneous work effort and progressive deliveries. For instance, as the aerotriangulation for one "block" of project area is completed, the orthorectification for this block is started while the balance of the aerotriangulation work for other blocks is completed. This process also supports progressive delivery of completed mapping to the client and enables the client to progressively review the data and organize/prepare/distribute for the intended applications.

If the work on a particular assignment phase is falling behind schedule the Project Manager immediately reviews the circumstances with the personnel who directly oversee the phase and corrective measures to accelerate the completion. These measures may include authorizing overtime or assigning additional equipment and/or staff to the work from Kucera's headquarters or branch production offices. Kucera's President or CEO in the role of Chief Administrator is kept abreast of the contract status at all times, and issues corporate directives as necessary for accelerating the schedule. In the event that deliveries are behind schedule, the Project Manager provides the client with a written report of the cause(s) and proposed course of action with corrective measures to be taken. This information will be subject to the client's approval and revised as required to meet with this approval.

The Project Manager is assisted in workflow monitoring/scheduling and quality control review oversight by the Quality Control Manager, who reports to the Project Manager and together with the Project Manager develops and implements production and quality control plans and address all production and quality issues immediately as they arise.

The primary responsibilities/assignments of the various project management team members are as follows:

Project Manager

- Primary point of contact
- Cost and time estimating
- Project team meetings
- Procedure plan development and distribution
- Receipt/review/maintenance/distribution of source materials
- Oversight of transmittals/deliveries
- Invoice triggering
- Status monitoring and reporting
- Issue management/resolution
- Quality control checks

Production Manager

- Production plan/critical plan development
- Workflow monitoring/scheduling
- Cost and time tracking/analysis/reporting
- Production issue resolution
- Production area supervision

Department Heads/Phase Managers

- Intra-department/phase work assignment/scheduling
- Department/phase level status monitoring/reporting
- Equipment calibration/maintenance
- Lead project technician/working supervisor
- Quality/standards certification
- Issue reporting/management

Quality Control Manager

- Develop and monitor project-specific QC plan
- Review QC certifications by department/phase
- Report/address quality issues/variances
- QC checks and certification of all final deliverables
- Production area supervision
- Workflow monitoring/scheduling

The Oblique Imaging Services Project Team:

GEOSPAN has a broad technical background. Its knowledge and experience include: surveying, mapping, photogrammetry, cartography, Geographic Information Systems (GIS), navigation, Global Positioning Systems (GPS), Inertial Navigation Systems (INS), computer systems and networks, video technology, computer imaging, database management and dynamic segmentation techniques.

Theodore M. Lachinski - President and founder of GEOSPAN

Education

University of Minnesota
USMCR Aerial Navigator

Highlights and Qualifications

Mr. Lachinski has thirty years experience developing innovative technological solutions. He has served as GEOSPAN's President and as a director since the company's inception in June 1990. Prior to founding GEOSPAN, Mr. Lachinski served as a Vice President of Technology for UltiMap Corporation and as the Systems and Data Processing Manager for Hennepin County MN, where he was directly responsible for the development of their Property Mapping and Highway Information Systems. He is the primary inventor of the GEOSPAN patent and a pioneer in the spatial information industry. In addition, Mr. Lachinski was a ten-year member of the City Council for Andover, Minnesota.

Stephen H Boggs - Vice President of Technology

Education

B.S., Honors, Biology, University of Illinois

Highlights and Qualifications

Mr. Boggs has 24 years experience providing system integration services. He has worked for GEOSPAN Corporation since 1992 with responsibility for developing the real time data acquisition and control software as well as GEOVISTA viewing software in end-user systems. Mr. Boggs is a co-inventor of the GEOVISTA process and has overall responsibility for the development and maintenance of all GEOVISTA software.

Jeffrey Setterholm - Geodetic Scientist

Education

B.S., Cum Laude, Engineering and Applied Science, Yale University
M.S., Science & Mathematics, Washington University
United States Air Force, Reese AB, Texas, 1970.Undergraduate Pilot Training
(Distinguished Graduate)
George AFB, California, 1970. F-4C ("Phantom") Combat Crew Training.

Highlights and Qualifications

Mr. Setterholm is a Geodetic Scientist with 24 years experience in applied spatial mathematics and is directly responsible for the development of GEOSPAN's 6-DOF data collection/processing and non-coplanar desktop surveying systems including GPS/INS post-processing and analytical support. He joined GEOSPAN Corporation in 1994 is also the inventor of GEOSPAN's U.S. Patent Pending – "Any Aspect Passive Volumetric Imaging Method." This pending patent automates surveying from imagery by creating 3D visualizations from multiple spatially accurate images.

GEOSPAN

Personnel Qualifications

Steven H. Gilkey – Project Manager

Education

Arizona State University B.S. Degree 1981; Major Business Administration

Highlights and Qualifications

Mr. Gilkey has twenty years of product development experience in the information technology industry. Since joining GEOSPAN Corporation in early 1996, Mr. Gilkey has been involved with all aspects of product development and project management of GEOSPAN's Government Sector offerings. Mr. Gilkey will be the GEOSPAN Project Manager.

Dennis Lockwald- Field Data Collection Manager

Education

Brown Institute Computer Networking 2003

Highlights and Qualifications

Mr. Lockwald Joined GEOSPAN in 2003 with a strong computer hardware and software understanding gained from his education along with an interest in technology. In 2005, Mr. Lockwald was promoted to Field Crew Manager after gaining a strong understanding of the best practices needed in the field to ensure quality data results.

Mr. Lockwald will oversee the imagery post-processing component of this project along with providing on-site support during the flight mission. Mr. Lockwald will provide daily Q/A on-site of imagery to ensure quality imagery is collected throughout the entire project before the aircraft and street level collection vehicles leaves the project site

- Street level imagery collection Crew Member 2003-2004
- Field Data Collection Manager 2005 to Present

REFERENCES

Provided below is a listing of clients for which Kucera International has recently provided digital vertical and oblique aerial photography, digital orthophotography, and/or updated planimetric/topographic base mapping services. Additional client references will be provided upon request.

Calhoun County, FL
Kathy Herrman – 850-674-5636
2010 – countywide (567 square miles) digital aerial photography, color digital orthophotography, digital oblique aerial imagery, application software, and training

City of Newport News, VA
Benjamin Scott – 757-926-3565
2010 – citywide (60 square miles) digital aerial photography, color digital orthophotography, digital oblique aerial imagery and application software, 3D city model

Cook County, IL
Alan Hobscheid – 312-603-1399
2010 – south triennial area (approximately 300 square miles) digital oblique aerial photography, application software, installation and training

MRT Inc. / Pike County, OH
Derrel Owens – 847-922-7980
2010 – countywide (440 square miles) digital aerial photography, color digital orthophotography, digital oblique aerial imagery

Davidson County, NC
Linda Hairston-Erwin – 336-242-2042
2009 – countywide (552 square miles) digital aerial photography, color digital orthophotography, updated planimetric feature mapping

Cobb County, GA
Ed Biggs – 770-528-8688
2000–2009 multiyear countywide (343 square miles) digital aerial photography, color digital orthophotography, updated DTM/topographic and planimetric feature mapping

Mahoning County / Youngstown, OH
Mike Marcis – 330-799-1581
2004 and 2008 – countywide (460 square miles) digital aerial photography, aerial lidar survey, color and infrared digital orthophotography, new and updated DTM/topographic and planimetric feature mapping. First performed in 2004, repeated in 2008.

Mecklenburg County / Charlotte, NC
Andy Goretti - 704-336-6192
2007 – countywide (528 square miles) digital aerial photography, aerial lidar survey, color digital orthophotography, DTM/contour topography

Moore and Hoke Counties, NC
Chris Koltyk – 910-947-5010
2007 – multi-county (1100 square miles) digital aerial photography, color and IR digital orthophotography, updated planimetric feature mapping

General:
Kucera International Inc. has been fully dedicated to providing high quality, cost effective aerial photography/sensing, photogrammetric mapping, geospatial data conversion, and related services for over 57 years. Today, Kucera stands as one of the largest and most experienced companies in the aerial mapping and geomatic services professions, annually completing hundreds of individual projects throughout the country and abroad covering areas ranging in size from a few acres to thousands of square miles.

County/City Base Mapping Experience:
Over the past decade Kucera International has performed aerial flyovers and has produced orthophoto and/or planimetric/DEM/topographic mapping covering over 250 counties and cities throughout the US covering over 150000 square miles. Kucera currently completes aerial flyovers and base mapping of approximately 30 counties and cities annually covering over 15000 square miles. The average size of the areas mapped is 600 to 700 square miles, and Kucera has mapped numerous multi-county regions and large individual counties covering over 1000 square miles. The map scales/resolutions and contour intervals have ranged from 1"=20'/0.20' pixel with 1' contours to 1"=600'/1 m pixel with 10' contours. The county and citywide mapping work has been performed predominantly at 1"=100' and 1"=200' scale with 0.25'- 1' pixel resolution and with 2' to 5' contours in ArcGIS, AutoCAD, ERADS, and Intergraph/Microstation GIS/CAD formats. The terrain mapped has ranged from mountainous (e.g., Estes Park, CO) to flat (e.g., Will County, IL), and from heavily urbanized (e.g., Houston, TX) to rural (e.g., Fulton County, OH).

Aerial Flyovers:
Kucera has been performing aerial photography and aerial sensing flyovers as a primary service throughout its 57+ year history. Kucera currently operates a fleet of three twin-engine (Piper Navajo Chieftain) and two single-engine aircraft (Cessna TU206) and has a leased helicopter (Bell Jet Ranger). With these aircraft Kucera completes over 600 individual flight missions annually from flight altitudes ranging from 300' to 24000'. A helicopter is used for large scale/high accuracy flyovers below 1200' altitude. Kucera's twin and single engine aircraft are used for flyovers from altitudes between 1200' and 12000', and twin-engine aircraft are used for high altitude (>12000') flyovers. In the past decade Kucera has performed aerial flyovers of sites in 35 different US states and three foreign countries. This work has included flyovers of over 250 different cities and counties and hundreds of smaller sites. Kucera's flight crew consists of five full time and two part-time pilots and seven aerial photographers/sensor operators. These individuals all have over two years of aerial photo/sensing flyover experience with an average of over 500 flight hours annually.

Two of Kucera's twin-engine Navajo Chieftain aircraft have two sensor holes, allowing two sensor systems to be carried to a site on the same mobilization and operated simultaneously when project specification and sensor settings permit.

Aerial Photography:
Kucera is one of the few firms with in-house capability to capture aerial imagery with the most advanced large format digital pushbroom/strip image capture technology, large format frame camera technology, and high resolution film camera technology.

Kucera has operated Leica ADS40 large format digital camera technology since 2005 and to date has acquired 4-band (RGBIR) high resolution (0.25' – 1' GSD) aerial imagery covering over 150000 square miles, including the entire State of Oregon in 2009. The ADS40 technology has received US Geological Survey's digital camera "manufacturer certification" and represents the most advanced of direct digital aerial image capture technologies, and using continuous sweep/pushbroom line scanning for direct acquisition of 4-band imagery in continuous flight strips ("pixel carpets") as opposed to individual exposures. The imagery is captured with 10 (6 panchromatic, 3 color, and 1 infrared) 12000 pixel CCD lines oriented for nadir (straight down) and forward and aft-looking views. Kucera's ADS40 cameras have 51 series sensor heads featuring improved image quality/flight condition latitude and capture of the color IR image band at the nadir position in full alignment with the color band. The ADS40 camera technology has advantages including reduced mosaicing/stitching, no image "fringing" from camera mis-alignments, reduced structure feature lean, superior feature resolution and shadow detail, improved stereo imaging, and distinct wavelength band separation for greater support of remote sensing analysis.

In 2010 Kucera acquired a Vexcel UltraCam X (UCX) large format digital frame camera system. The UCX system is ideal for efficient capture of high resolution 4-band aerial photo imagery, having the largest image footprint (14400 x 9420 pixels) and highest resolving power of any digital aerial camera system currently in use. The Vexcel camera can directly capture imagery at a specified resolution from a higher flying altitude than other digital camera systems, allowing for reduced flyover time and optional image capture efficiency.
Both the ADS and Vexcel digital camera systems operated by Kucera have integrated first order airborne GPS/IMU technology (Leica IPAS, Novatel SPAN) for accurate in-flight sensor georeferencing. The AGPS/IMU units in Kucera's digital cameras have the ability to observe and process both the GNSS (US) and GLONASS (Russian) GPS satellite positions, thus maximizing satellite transmission data capture and maintaining optimal georeferencing accuracy throughout the flyover mission.

Kucera also annually performs color, color infrared, and/or black and white aerial film photography of hundreds of sites throughout the country. Kucera currently operates four USGS-calibrated, high-resolution film based aerial camera systems (Zeiss RMK TOP and Jena LMK) and two large format digital aerial camera systems (Leica ADS40). All of Kucera's cameras are interfaced with airborne GPS/IMU systems (Applanix POS/AV) for accurate, in-flight image georeferencing. Kucera has used airborne GPS/IMU in-flight control/georeferencing capability since 1997 and currently performs virtually all photo missions using AGPS/IMU technology and procedures.

Kucera has full service aerial photo laboratories operating at its headquarters and three satellite office facilities for aerial film processing and photo reproduction/printing work. The labs are equipped with automatic roll and sheet film processors, color and black and white contact printers, rectifying photo enlargers, and engineering copy cameras. Kucera currently processes over 50 rolls of aerial film annually and has film processing procedures quality-control certified by both major aerial film manufacturers (Kodak and AGFA). Kucera's photo lab staff includes six film processing/inspection and photo reproduction specialists with an average experience level of over 20 years.

Remote Sensing:

Kucera has been performing aerial multi-spectral and thermal imaging since the 1970s, initially with Bendix multi-spectral/thermal scanners and in recent years with WASP (Wildfire Aerial Sensor Program) multi-spectral/thermal cameras developed by the Rochester Institute of Technology (RIT). The WASP systems capture visible imagery to a 0.3' resolution and shortwave, midwave, and longwave bands to a 2' resolution. Kucera has operated the WASP technology since 2006 and has performed multi-spectral and/or thermal surveys of controlled forest fire burns in five states, power plant cooling pond sites in two states, and various other sites throughout the State of New York. Kucera also performed combined WASP and lidar surveys of earthquake damaged areas in Haiti in 2010 under contract with RIT and the World Bank.

A unique feature of the WASP imagery is that it is georeferenced via sensor-integrated airborne GPS/IMU systems and can be furnished in ortho-rectified form. Kucera in conjunction with RIT has produced WASP-based multispectral orthophotography for numerous sites.

Kucera has also performed airborne multispectral surveys using an Argon ST system through association with Baker Associates (Ann Arbor, MI), and airborne hyperspectal surveys using an AISA Eagle system through association with Galileo Group (Melbourne, FL). The systems are operated from Kucera's twin- or single-engine aircraft and feature 400 – 1000nm spectral range with simultaneous (Argon ST) or separate 128 channel (AISA Eagle) spectral data acquisition.

Aerial LiDAR Surveying:

Kucera International Inc. has been performing aerial lidar surveying and return classification in-house since 2003 and to date has completed aerial lidar surveys covering over 60000 square miles throughout the US and abroad.

From 2003 through 2009 Kucera operated Leica ALS40 55kHz and ALS60 85 kHz lidar systems having a smooth operational envelope (ability to be operated from any flying altitude from 600' – 15000') automated roll stabilization to maintain proper scan width and increase data capture efficiency and accuracy, intensity return capture, and four return readings per pulse with minimized beam divergence and a guaranteed reading of the last return, i.e., return with the highest probability of representing ground.

Since 2009 Kucera has operated latest generation Leica ALS60 aerial lidar technology and currently operates two ALS60 systems from twin-engine Piper Navajo Chieftain and single-engine Cessna TU206 aircraft. The ALS60 lidar technology includes all the advanced features of the previous generation ALS systems and has unique Multiple Pulse in the Air (MPiA) capability. MPiA allows for emission of a second pulse before return of previously sent pulse, in effect doubling the point return density achieved from any flying altitude without lowering the signal-to-noise ratio, thus increasing return accuracy or permitting use of higher flying altitudes to achieve required point densities. The ALS60 systems also have integrated Leica IPAS airborne GPS/IMU georeferencing systems which can observe both the US and Russian/GLONASS satellite constellations and thus maximize observation redundancy and accuracy.

Kucera has been performing lidar data processing/classification in-house using robust TerraSolid Terramodeler and Terrascan surface modeling programs since 2003 and currently has six experienced (>5 years) lidar processing/classification specialists on staff. Kucera's two advanced lidar capture systems and six lidar processing specialists provide the capability to complete aerial lidar capture and provide high accuracy/contour generation grade classified lidar return covering over 30000 square miles annually. The bare earth accuracies achieved by Kucera have been superior (0.3' and better) and the subject of technology assessment/justification reports by several of Kucera's clients. (e.g., NYS DOT, Rochester Institute of Technology).

Oblique Aerial Imaging and 3D Modeling:

Kucera performs aerial oblique imaging through a partnership with GeoSpan Corporation of Minneapolis, Minnesota. GeoSpan's GeoVista 8-camera oblique imaging system is operated from Kucera's twin or single engine aircraft. The twin-engine aircraft has two sensor holes, allowing Kucera to operate a second sensor such as a lidar system or large format digital vertical camera in addition to the oblique imaging system.

The GeoVista system includes 45 ° oblique forward, aft, left and right looking cameras and a straight down looking/vertical imaging camera, all of which are integrated with a high accuracy Novatel/Kearfott airborne GPS/IMU system for direct in-flight georeferencing of the captured imagery. A major feature/advantage of the GeoVista oblique image systems are the system's 21 megapixel EOS-1D Mark III Cannon digital cameras, which have a higher resolution than the sub-20 megapixel cameras used in other oblique imaging systems. The 21 megapixel cameras capture higher quality oblique imagery when used from the same altitude as other oblique imaging systems, and can capture equivalent quality imagery from higher flying altitudes. The georeferencing of the captured oblique imagery is performed by using GeoSpan's patented 6 degree of freedom (6-DOF) GPS/IMU measurement-based process. The georeferenced imagery will have an absolute horizontal accuracy within 6.7' for 90% or more of measured points, which can be checked, verified, and reported using targeted ground-based control.

The basic oblique image deliverables include the 4-way georeferenced imagery at a front line resolution of up to 3" and a perpetual license to the GeoVista viewing software/Application Program Interface (API). The georeferenced imagery is provided in TIFF, JPEG, or other specified raster image formats. The GeoVista API viewing software includes the ability to call individual or multiple selected views on the screen and measurement tools for determination of heights, distances, polyline lengths, areas, and 3D locations. The software can be provided in stand-alone, ArcGIS desktop, or ArcIMS browser platform-compatible form.

Kucera has produced basic 3D model, dynamic "flythroughs" for a number of clients using combined oblique imagery, orthophotography, and lidar return. More complex 3D models are produced through partnerships with Cyber City of El Segundo, California and Simwright Inc. of Navarre, Florida.

Ground Surveying:

Kucera has full in-house GPS and conventional ground survey capability and currently completes over 50 countywide, citywide, and other large area control surveys annually involving establishment of thousands of individual targeted/monumented or photo-identifiable ground control points. Kucera's experience includes existing control recovery, new permanent or semi-permanent control establishment, targeting, and photo-identifiable control surveying in all types of terrain. The surveys are performed to first, second, or third order horizontal and vertical accuracy on the local, state plane, national/UTM or other designated datums. The survey technology used includes first order geodetic grade, VR5-compatible GPS receivers (Trimble 5700 and 5800 series) and first or second order total stations (Topcon) and automated leveling instruments (Wild NA2). Kucera's GPS survey work is performed in a static or kinematic fashion and includes operation of ground base stations for airborne GPS control surveys. Kucera's survey staff of six (three two-man crews) has an average individual experience level of over 20 years and includes surveyors licensed in over 15 different states.

In addition to ground control surveys, Kucera regularly performs engineering/construction, well/drill hole, utility, boundary, earthwork, topographic, hydrographic, and cross-section/profile ground surveys using GPS and conventional survey technologies. Kucera performs ground-based LiDAR surveys with a leased Leica/Cyrex ground-based laser mapping/LiDAR system.

Kucera regularly produces color and black and white plots of digital imagery and mapping on HP1050C and AGFA Grand Sherpa plotting systems. Kucera has operated HP high resolution inkjet plotting systems since 1991 and with these systems produces standard inkjet plots at resolutions up to 600 dpi. The Grand Sherpa system has a 1400+ dpi resolution and uses solvent inks to produce photographic quality, fully archivable plots/prints up to 70" in width. Kucera has operated AGFA large format, photo quality plotting systems since 1998 and has produced hundreds of image plots/prints on these systems.

Aerotriangulation:

Kucera has been performing analytical aerotriangulation in-house since 1975 and digital/softcopy aerotriangulation in-house since 1996. Currently, Kucera triangulates thousands of individual stereomodels annually using each technology. The choice of triangulation method is based on evaluation of and experience with the specific project terrain, project mapping requirements, aerial flyover and ground control pattern, size/number of exposures, and other factors, with both methods being tested as needed to determine which is optimal. Both methods use photo center and orientation data from the airborne GPS/IMU survey as initial input, which allows the process to reach a final solution with a minimum number of iterations/repeat run-throughs. Softcopy triangulation is more frequently used due to its greater accuracy/redundancy and efficiency for larger projects with textured terrain supporting the image correlation process. For projects having no digital imagery requirements or having a predominance of non-textured terrain such as water bodies, forestlands, and swamplands, analytical aerotriangulation methods with manual triangulation point selection are typically used for increased accuracy and efficiency.

Kucera runs several different triangulation adjustment programs (RABATS, MATCHAT, PATB, ORIMA) and for a particular project uses the program which is optimal in terms of the type of triangulation process used, source data input, data output requirements, and triangulation accuracies achieved. The triangulation results are evaluated for conformance with rigorous accuracy tolerances, with triangulation error residuals behind held to within half of the allowed mapping displacements. Kucera has a triangulation staff of two analytical and three softcopy triangulation specialists, all with over five years experience in triangulation and mapping processes.

Orthophotography:

Kucera has been directly producing color, black and white, color infrared, and multispectral, 4-band digital orthophotography in-house since 1994 and currently produces over 30,000 individual ortho image tiles annually on eight dedicated orthophoto stations (Inpho OrthoMaster and Z/I OrthoPro). Kucera has an in-house digital orthophoto production staff of 12 rectification and image processing/edit technicians with an average individual experience level of over five years.

Kucera's digital orthophoto production process includes initial DEM/DTM and digital image source data organization and quality control review, batch image rectification and resampling to the target pixel resolution, manual review of the image rectification/geometric accuracy, automated image mosaicing, tone balancing, and tiling (Inpho OrthoVista technology) and final full manual review, edit, and certification of proper geometric accuracy, radiometric quality, image content, and data organization. Kucera's orthophotography has received superior quality ratings from numerous state and regional multi-jurisdictional review organizations.

Kucera currently provides digital orthophotography at resolutions ranging from 0.2' to 2m in a variety of uncompressed (e.g., TIF/TFW, GEOTIFF, BIL, COT) and compressed (e.g., SID, ECW, JPEG) data formats using a variety of image coverage/tiling systems (e.g., coordinate grid-defined modular, PLSS/land section, USGS quarter-grid, areawide mosaic). Optional services/products Kucera often provides include latitude/longitude reprojections, "true" orthophotography, anaglyph (stereo) orthophotography, image catalog/quality control utilities, image watermarks for data security, and 3D GIS visualizations/fly-throughs. Delivery media commonly used include exchangeable hard drive (e.g. USB, firewire), DVD and CD-ROM.

Stereocompilation:

Kucera has been performing photogrammetric feature stereocompilation in-house since the 1950s and has direct digital stereocompilation capability since the early 1980s. Kucera currently performs direct digital stereocompilation of thousands of stereomodels of aerial imagery annually on each of eight high-end softcopy (Z/I SSK, BAE SOCET SET, Cardinal Systems VR2) and six first order analytical (Zeiss P2, P3) stereoplotting systems operated by a dedicated stereocompilation staff of 14 with an average individual experience level of over 15 years. The stereocompilation projects cover areas ranging in size from a few areas to thousands of square miles and having a wide variety of terrain and land cover. All stereocompiled data is digitally captured in three dimensions from fully parallax-cleared and rigorously oriented project imagery.

Kucera regularly performs feature-type specific or total visible planimetric data (roads, structures, hydrography, etc.) compilation at target map scales ranging from 1"=10' to 1"=1000'. The compilation is conducted in a fashion which optimally supports the client's intended/potential GIS/CAD applications, with specific data types being compiled/recorded in separately coded "layers", area features (e.g., structure footprints, water bodies) being compiled as closed polygons for area/centroid determination/attributing, and line features (e.g., road centerlines, streams) being compiled in continuous fashion for directionality/attribute range assignment and network development.

Kucera has been stereocompiling digital terrain and elevation model (DTM/DEM) data in various forms since the early 1980s for ortho-rectification, contour generation, earthwork/volume surveys, 3D modeling, and other applications. The DTM/DEM components typically compiled include a project wide "mass" point grid, spot elevations at high and low terrain points and on prominent features, "breaklines" and "skeletal lines" for significant abrupt and more gradual changes in grade, respectively, and outlines of obscured areas where the ground cannot be readily seen in the imagery due to vegetation or other causes and where the LiDAR data and mapping generated from the same are approximation only. DEM/DTM mass point grids are manually stereocompiled generated through advanced photogrammetric autocorrelation technology (BAE NGate) or acquired via aerial LiDAR survey and photogrammetrically checked and augmented. Methods of breakline compilation used by Kucera include stereocompilation from stereo aerial photography, digitizing from digital orthophotography, use of existing feature datasets, and lidargrammetry" – based compilation from synthetic stereo lidar intensity imagery. The breakline production is performed on Kucera's Cardinal Systems VR2 and BAE Socet Set softcopy stereoplotters, which support full stereo image display and 3D breakline and other planimetric feature data capture from digital aerial photography or lidar return.

The type and corresponding density of DEM/DTM components compiled is based on the type and accuracy of the product mapping, type of terrain, and availability of uncompiled source terrain data, such as bare earth LiDAR points. All DEM/DTM data is subject to several quality control checks before delivery and/or used, including review of 3D perspective views of the data, generation and review of "check" contour topography, and evaluation of interpolated DEM/DTM point elevations against elevations of corresponding control points in the coverage area.

Kucera has been performing DEM/DTM and digital planimetric/topographic update mapping in-house for over ten years and has successfully completed numerous county/citywide and smaller area update mapping projects in various GIS environments, including ArcGIS, Microstation/MGE, and AutoCAD. Kucera uses specialized update procedures and programs for each GIS/CAD environment and data type, such as routines for automated source data review and maintenance of attribute data links in the update/conversion process. Update compilation work is performed on Kucera's softcopy stereocompilation systems having features such as rapid panning and vector/raster data superimposition which optimize the update process. In the process the existing mapping for the entire designated update area is carefully checked in stereo against the new aerial imagery, with features being added, removed, and replaced or changed as needed to produce a current representation. The existing mapping characteristics and update criteria are thoroughly reviewed by Kucera and clarifications sought from the client as needed before commencing the updating.

Data Review/Edit and GIS Conversion:
All of Kucera's newly stereocompiled/digitized and updated feature mapping is subject to an independent quality control review and edit as a separate work phase prior to final data conversion and/or delivery. The review/edit is accomplished in the native data capture and target data format on eight dedicated GIS/CAD stations operated by a staff of 12 editing/QC and GIS specialists with an average individual experience level of over 10 years.

The initial data edit process includes full manual review and a series of batch and manual edit routines to create clean, seamless data coverage for conversion to the designated GIS/CAD format as needed. Checkplots of the edited mapping are produced for internal review and forwarded for client inspection as needed.

Kucera has been regularly performing conversions to ArcInfo/ArcGIS, AutoCAD, Microstation/DGN, and other GIS/CAD formats using proven processes/technologies for over 15 years and currently completes hundreds of such conversions annually. Conversions to AutoCAD and Microstation/DGN and accomplished with direct binary data translations. Conversions to ArcGIS and other GIS/CAD formats are performed through the DXF exchange format. The conversion process uses translation tables based on the project GIS/CAD database design. Converted map data is subject to routines for data cleaning/scrubbing, GIS topology building, and attribute assignment as needed. All converted data is subject to full manual review, testing, and final edit directly in the target GIS/CAD environment, including generation of checkplots and conversion reports for quality inspection/certification.

Metadata:
Kucera has been providing metadata in FGDC-compliant and other forms (e.g., SCGS, NC LRMP) for digital orthophoto, planimetric/topographic feature mapping since the mid-1990s and currently provides metadata for 20 to 30 large mapping projects annually. FGDC-compliant metadata is created through ArcGIS or independent programs such as the USGS TKME program. Other forms of metadata are produced through in-house program scripts. Clients requiring metadata are provided with sample data and/or a metadata questionnaire to help ensure that the data is complete and accurate.

GIS Support:
Kucera's GIS staff includes four or more individuals with advanced experience and/or training in current and recent past releases of ArcGIS, AutoCAD, Microstation, Terramodel, and ERDAS GIS/CAD systems, and two individuals with experience in Intergraph MGE and Geomedia environments. The staff regularly performs database design data conversion, direct data digitizing, topological data structuring, and attribute assignment and transfer, database linkages, data overlays, data review/editing, and a variety of GIS applications (e.g., impervious surface calculations, road address assignment, water flow networks, etc.) in these environments. Kucera also regularly provides application specific and general training and consulting for ArcGIS and AutoCAD. Kucera is an authorized ESRI GIS Business Consultant.

Cadastral and Land Use/Land Cover Mapping:
Kucera has been performing cadastral and land use/land cover (LU/LC) mapping in-house for over 20 years and has completed over 20 large projects of this nature covering counties and cities throughout the US. Kucera has eight cadastral mapping and land use/land cover interpretation specialists on staff with an average individual experience level of over 10 years. The staff is experienced in both "best-fit" digitizing and coordinate geometry/COGO methods of cadastral mapping and with the use of a variety of land use/land cover classification systems. The conversion is performed directly in the target GIS/CAD environment using a GIS/CAD database design developed together with the client. Following initial data entry and inspection/edit, the GIS data structure is created as necessary, including building of polygon topology, database linkages, assignment/transfer of attributes, etc. Kucera has worked extensively in the ArcGIS, AutoCAD, MicroStation, and other common cadastral and land use/land cover GIS/CAD environments. Kucera also regularly provides digital parcel and land use/land cover map maintenance and training.

Thorough collaboration with Cornell University's Institute for Resource Information Services (IRIS) Kucera has performed land use/land cover mapping of Medina County, Ohio and other areas throughout the County. Cornell's IRIS and Kucera's photo interpretation staff has extensive experience with LU/LC classification systems such as the Anderson system and its various modified forms.

January 26, 2011

City of Branson
110 W. Maddux Street
Suite 310
Branson, MO 65616

Attn: Curtis J. Copeland, GIS Coordinator

Re: RFP for Digital Orthophotography, Digital Topographic Mapping and Oblique Photography

Dear Mr. Copeland and the City of Branson:

Pictometry is pleased to submit its response to the City of Branson's RFP for Digital Orthophotography, Digital Topographic Mapping and Oblique Photography. The orthogonal and oblique imagery and software requirements of this RFP will easily be captured, processed, delivered and fulfilled by Pictometry for this project. We have captured obliques and orthogonal images for over 925 county governments and have successfully captured imagery in all 50 states. With over 33 counties and municipalities as current customers in Missouri and a fleet of 53 single- and multi-engine aircraft, Pictometry can easily complete this project for the City of Branson in its preferred capture timeframe.

Pictometry's PentaView camera system will capture the 4-inch AccuPlus five-way oblique and orthogonal imagery simultaneously, with a separate flight(s) to capture the Standard 12-inch three-way oblique imagery. The LiDAR data we will capture will be used to orthorectify the imagery, improve the accuracy of the obliques, and create the highly accurate AccuPlus mosaics. It will also be used to produce the Digital Terrain Model (DTM) that will enable the creation of the 2-foot contours. Standard and Transportation Breaklines will also be included in the deliverables.

As always, all of the imagery for this project will be processed in the US at Pictometry's Rochester, NY headquarters. With over 1.5 petabytes of storage currently available and increasing, Pictometry commits to keeping the City of Branson's imagery and LiDAR data on file in a secure format for possible future projects and development.

We thank you for having the opportunity to respond to your bid with our groundbreaking AccuPLUS technology and we look forward to the possibility in working with the City of Branson on this project.

Respectfully Submitted,

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1. Scope of Work

Executive Summary of Proposal

Pictometry's base response to the City of Branson will provide the following deliverables:

- 4-inch GSD five-way color AccuPlus orthogonal and oblique images delivered in TIFF on a portable hard drive(s)
- 12-inch GSD three-way color, geo-referenced Standard orthogonal and oblique images delivered in TIFF file format
- 4-inch GSD color balanced and seamless AccuPlus ortho mosaics; 12-inch = 1-meter mosaic
- Aerial triangulation to ensure proper frame alignment and overall accuracy
- Optional LiDAR taken at 1.0 meter point spacing
- Creation of a Digital Terrain Model (DTM) (with LiDAR capture)
- 2-foot contours derived using DTM (with LiDAR capture)
- Self-Hosting Pictometry Online
- Unlimited seat license for Pictometry's Electronic Field Study (EFS) Client Software
- Disaster response assurance through Pictometry Economic Alliance Program (EAP)

1.1 AccuPlus Orthophotography and Oblique Imagery

The Orthogonal Pictometry Advantage

There are a number of significant advantages to AccuPlus ortho mosaics produced from Pictometry's imagery. First, because Pictometry captures imagery from low altitudes, there are less atmospheric distortions in the imagery – an important characteristic in larger cities or areas with greater concentrations of airborne particulates that can blur the image or decrease the contrast and visual detail of the mosaic. Second, the lower flight altitude also results in better accuracies since any angular errors have a decreased effect on final positional accuracy. Third, because Pictometry uses small field of view cameras, the effects of building lean are reduced. Fourth, because Pictometry routinely captures over 100 images per square mile, there are more actual nadir points in the resulting ortho mosaic. The result is an ortho mosaic with very high resolution and clarity. Finally, the ability to capture obliques at the same time as capturing the ortho imagery provides our customers with unparalleled consistency in the varying image views.

The USGS recently reviewed Pictometry's AccuPlus products for inclusion into authoritative/definitive maps, as well as Pictometry method of AccuPlus image acquisition. All parties agreed that the Pictometry AccuPlus ortho-mosaic products were of high quality and met or exceeded the standards tested to by the USGS. As a result, the USGS and its customers and business partners have authorized Pictometry as a valid source of definitive ortho-mosaic products and will fund Pictometry AccuPlus collections through the USGS Liaison Program.

Technical Specifications

Image Capture:	Single flight capture of 4-inch color RGB imagery. Orthogonal and oblique imagery captured simultaneously with Pictometry's five-camera rig. Separate flight capture of 12-inch three-way color RGB imagery. Orthogonal and oblique imagery captured simultaneously.
GSD:	4-inch and 12-inch
Imagery:	Seamless AccuPlus RGB 4-inch Ortho Mosaic, and 1-meter mosaic from 12-inch GSD
Flight Altitude (AGL):	4-inch = 2,500 feet AGL; 12-inch = 4,500 feet AGL
Coordinate System:	Missouri Central State Plane Coordinates NAD83, NAVD88 – Geoid03 corrected

Format: TIFF or GeoTIFF format, 8-bit, 3-band RGB
Tile Size: 10,000' x 10,000' or as specified
Accuracy: 4-inch AccuPlus: $RMSE_r$ = 1.41 ft, NSSDA (95%)
12-inch Standard from FOV: 10.4 inches, + 0.3% (± 1m GSE)

Image Metadata
FGDC-compliant metadata will be provided for the deliverable orthophotography data sets. This metadata will be completed using standard industry metadata tools and output in standard file formats for viewing in all widely available viewing utilities.

AccuPlus Oblique Imagery

Pictometry's PentaView camera system is rigged to capture oblique images simultaneously with orthogonal images. Pictometry's camera system is the **only USGS-certified oblique aerial capture system** in America. The oblique and orthogonal cameras have been certified by the USGS as capable of providing quality, consistent image data to support civil government programs at the performance level specified in the USGS Sensor Type Certification Report.

Pictometry creates its metric oblique images without requiring the traditional authoritative ortho-photos to do so. What really sets Pictometry's PentaView derived products apart is the metric oblique image. When Pictometry captures a forward, rear-ward, or side-ward looking oblique image (see image below), it is much more than just a pretty picture. All of Pictometry's images are Intelligent Images, meaning an operator can measure distances, locations, areas, heights and more, all with a simple click of the mouse. There is no need for stereo-pair analysis or aero-triangulation. A single image is all that is needed to make the measurement.

Pictometry's PentaView capture system

2. Project Approach and Schedule

2.1 Project Management

Ms. Neal-Vacca will manage development of the City's imagery flight plans and oversee the image and data captures. Ms. Neal-Vacca will work closely with the City of Branson to ensure that clear expectations are set and communication is constant. Throughout the duration of the project, Ms. Neal-Vacca will set up and participate in status calls with the members of the team. She will work to integrate any geo-spatial data sets that the City might want overlain, and maintain daily communication with the City during the image capture process. Ms. Neal-Vacca will work closely with the various Pictometry internal departments to ensure that the deliverables meet the bid specifications and that training of its users has been scheduled and completed. Ms. Neal-Vacca is located in Pictometry's Rochester office at 100 Town Centre Drive, Suite A, Rochester, NY 14623, and can be reached at 585-486-0093, ext. 367.

2.2 Project Pre-Planning

Horizontal and Vertical Control Surveys – Pictometry will capture ground control survey points prior to the AccuPlus imagery being captured for the City of Branson project. GPS technology will be employed to establish the control. The coordinates will be based on the Missouri Central State Plane Coordinate System, NAD 83/NAVD88 in U.S. Survey feet. These control points will be documented and included with the end product.

Flight Planning – Pictometry will prepare flight plans taking air safety, elevation, frame overlap and GSD into account. The flight map will show the approximate location of each flight line.

Aerial Triangulation – Using the aerial photography and basic field control, Pictometry will perform Aerial Triangulation (AT) to obtain the additional orientation control. This AAT plan will accurately determine the location and size of the planned adjustment blocks.

Ground Control – Pictometry will utilize the National Geodetic Survey's Continuously Operating Reference Station (CORS) Network data whenever possible.

2.3 Data Acquisition

Pictometry's PentaView Camera System
Pictometry's PentaView digital camera capture system can create orthorectified images that are metric, geo-referenced, and highly accurate. The equipment in this capture system is comprised of a:

- 16-megapixel small format digital camera
- Custom photogrammetric lenses
- GPS/INS system with a fiber-optic IMU
- GPS Reference Station

The camera lenses were designed by Pictometry specifically for airborne aerial imaging applications. They have minimal radial distortions, a strong MTF, a very flat field of view, strong color correlation, and a very high speed, all of which combine to create highly-detailed, minimally distorted source images for the orthorectification process.

Camera Calibrations
Pictometry pioneered and developed a highly accurate digital camera calibration procedure which was also licensed to the USGS for use at their EROS data center. Each of Pictometry's cameras is geometrically calibrated using Pictometry's camera calibration process which precisely measures the interior geometry of each camera, enabling the production of highly accurate metric imagery and also detects any pixel aberrations. Additionally, the cameras are radiometrically calibrated so that the images can be color balanced to remove differences caused by changing atmospheric and sun conditions.

Pictometry Aircraft Specifications and Procedures
Pictometry currently has 53 dedicated single- and multi-engine aircraft and flight crews in operation for our Oblique, Orthogonal, Infrared imaging, and LiDAR data operations. All pilots have been extensively trained in

Pictometry's technology, policies and procedures. They fly and operate the Pictometry capture system in accordance with the regulations of the Federal Aviation Administration and the Civil Aeronautics Board. Pictometry's fleet of aircraft consists primarily of Cessna 172's; however 4 of the 53 aircraft are Piper Aztec multi-engine planes which are capable of handling the LiDAR captures and special needs that single engine aircraft cannot. The actual number of aircraft utilized for image capture and the duration of participation of each of the aircraft will be dependent to some degree upon Air Traffic Control (ATC) and weather conditions. Additionally, a twin engine aircraft will be utilized to perform the LiDAR data collection of this project.

Capture Parameters

Digital orthogonal aerial imagery will be collected to provide source data for the creation of orthophotography. The collected data will conform to the following:

- Pictometry will utilize source imagery with nominal 4- and 12-inch GSDs to support generation of 4-inch GSD AccuPlus RGB ortho mosaic tiles, and an area-wide 1 meter mosaic
- Imagery will be captured with a nominal forward overlap of 60% and side overlap of 30% in order to ensure full stereo coverage. Any areas without full stereo coverage will be recollected at Pictometry's expense.
- Imagery with excessive crab, tilt or pitch will be recollected at Pictometry's expense. Due to the small format of Pictometry's camera, and automatic aerial triangulation techniques available, crab in excess of 3 degrees will not necessarily require recapture. Pictometry will limit its sensor to 6 degrees of tilt and pitch; this limit can be utilized due to the narrow field of view which limits the off-nadir distance at the edge of the frame, thus minimizing feature lean.
- All imagery shall be captured to conform to the American Society for Photogrammetry and Remote Sensing (ASPRS) Draft Aerial Photography Standard (1995), (see, for reference: www.asprs.org/asprs/resources/standards/photography.htm) with the exception of all requirements specific to film and/or shuttered cameras and the following:

Pictometry will limit the imagery sensors to 6 degrees roll and pitch. Pictometry's imaging system does not show detrimental effects on resolution due to aircraft vibration without a system to fully isolate the sensor from the sensor from vibrations of the aircraft, and does not require experienced operators.

Image Post Processing

Pictometry processes all of its imagery in the United States at our headquarters in Rochester, NY. Upon arrival in our Rochester Processing Center, the imagery will be copied to Pictometry's servers and prepared for post-processing. Post-processing takes place in two general phases: Airborne GPS/INS and Image Processing.

Airborne GPS/INS

During the acquisition of the imagery, dual frequency geodetic receivers will be used on one or more ground control reference stations and in the aircraft. All instruments will collect data at a sampling rate of 1.0 second or better with the INS logging photograph exposure times as external events. Pictometry will closely monitor the PDOP in order to ensure high quality GPS/INS data is acquired.

Pictometry will undertake all GPS data processing, transformations, and interpolations to derive coordinates of the perspective center of the aerial camera for exposure. Pictometry will utilize the latest available technology to post-process GPS/INS data including tightly coupled solution methods.

Once the post processing of the GPS/INS data is complete, Pictometry will then convert the exterior orientation (EO) parameters from the navigation frame to the mapping frame (Missouri Central State Plane Coordinates, NAD 83, NAVD88 in US Survey Feet) for Automatic Aerial Triangulation.

Image Processing

Concurrent with the GPS/INS processing, the imagery in RAW format will be 'developed' to uncompressed TIF format. After the development process, the imagery will be put through a rigorous QA/QC process whereby

images of low quality, due to either improper exposure or sensor artifact, are identified and marked for recapture. Pictometry uses both automated software it has created (proprietary) and human examination when considering whether to reject an image or pass it for orthophoto production. Pictometry's Image Processing Department checks for any of dozens of possible defects while assessing the quality of the imagery.
Once the Airborne GPS/INS data has been successfully post-processed, the resultant trajectory (SBET) will be applied along with the bore sight and camera model to the nadir imagery. At this point, the imagery will be put through a second rigorous QA/QC process in which the relative and absolute accuracy of the imagery will be evaluated. Imagery that does not meet specifications will then be marked for recapture. Once the imagery is deemed to have passed the QA/QC process, the nadir imagery will move into the Aerial Triangulation portion of the process.

2.4 Aerial Triangulation

The Aerial Triangulation process is performed on nadir frames and begins as soon as a block has been processed to TIFF format, directly registered exterior orientations from the post-processed GPS/INS trajectory have been applied, and the imagery has passed the second QA/QC process.

Automatic Aerial Triangulation (AAT)
Pictometry will be responsible for and perform automatic aerial triangulation (AAT) on all imagery for use in production of ortho mosaics and stereo models. The AAT process will make use of the directly observed exterior orientation (EO) of each exposure, i.e. the position and orientation of each exposure derived from the GPS and INS data. The use of GPS/INS data will allow for the use of fewer ground control points than would otherwise be required since the xyz of each exposure serves as a control point in the bundle adjustment, providing a useful means of blunder detection. Additionally, the use of GPS/INS data expedites the automatic tie point generation process by providing a high degree of correlation between the frames during the matching phase. Pictometry will utilize Inpho's Match-AT software to perform the AAT.

Bundle Adjustment
Pictometry will use Inpho's Match-AT software for the final bundle adjustments. Pictometry will review all residuals between control points and tie points, and compare the check points' values to actual control. Pictometry will perform quality control procedures to prepare a statistical analysis of the error propagation and theoretical accuracy. If the control points are not within range or statistical analysis indicates weak ties between images, new manual tie points are added to increase the strength of the solution.

Control points on the photography will be checked against control actually used to ensure that all available control was observed. Control and tie point residuals from the final bundle adjustment will be examined and checked against project specifications.

The bundle adjustment will be performed with a portion of the GCPs set as check points to verify the accuracy of the aerial triangulation adjustment. The RMSE error of the calculated point coordinates as compared to the surveyed point coordinates will be reported. For the final adjustment, all points will be used as control in order to obtain the strongest possible solution.

If requested, Pictometry will generate final triangulated EO files and provide to the City a brief report, the AT log and statistics files containing detailed information including, but not limited to, a summary of aerial triangulation results and the measurement residuals of all control, check, and GPS/INS observations.

2.5 Ortho Image Production

Following the aerial triangulation phase, the nadir imagery is passed into the ortho imagery production phase. This includes orthorectification and mosaicking of individual frames to create a single area-wide image which will be tiled for delivery.

Orthorectification - Orthorectification will be performed using the LiDAR data captured for this project, the exterior orientations generated during the aerial triangulation phase, and the camera models generated by Pictometry's calibration process. These three data pieces are used to remap the nadir images to a rectilinear north-up grid and to remove distortions caused by the variability of the terrain. As is the industry standard, a cubic convolution method will be used to perform the required resampling during the ortho rectification process.

Mosaicking - The mosaicking portion of the project consists of two major steps: radiometric balancing and seamline selection. Pictometry will utilize both its proprietary software and Inpho's OrthoVista software package to perform the radiometric balancing. Additionally, local adjustments of brightness values, color, and contrast will be performed as necessary. The final 4-inch GSD RGB AccuPlus mosaics will have no significant radiometric seam edges between orthophotos.

Following radiometric balancing, the OrthoVista software package will be utilized to generate automatic seamlines between source frames. The automatically generated seamlines will be manually edited to eliminate feature misalignment due to seamlines which pass through features located above the DTM. Pictometry will minimize seamlines through buildings in this way, and will perform manual corrections where seamlines through buildings are unavoidable.

In addition to editing for geometric considerations, Pictometry will also edit seam line placement for aesthetic purposes, including elimination of split vehicles and shadows where possible. During the seam editing process, Pictometry will verify that feature alignment across seamlines is 3 pixels or better.

Building Correction - Features which are elevated with respect to the DTM are subject to scale increase and radial displacement (e.g. building lean). Due to the narrow field of view of Pictometry's small format camera, building lean is minimized in most cases. An additional effect of the use of the small format camera is that very tall buildings may be subject to greater scale increase. Pictometry will manually correct buildings which obstruct transportation features due to either scale increase or building lean.

Bridge displacement

Manually corrected bridge

Bridge and Water Correction - As with buildings and other elevated features, bridges are subject to the effects of scale increase and radial displacement. Pictometry will manually correct bridges as necessary in order to ensure proper planimetric placement and to eliminate distortion due to variances in the DTM below the bridge deck.

Additionally, in order to preserve uniformity of appearance, Pictometry will utilize the seam editing process to attempt to source water bodies from a single frame where possible. In areas where this is not possible, Pictometry will manually smooth differences in the color of water bodies and/or apply a single color to said water bodies.

Tiling - Upon completion of the area wide mosaic, Pictometry will tile the imagery to the agreed upon schema for delivery.

3. Software Deliverables

3.1 Client Viewing Software – Electronic Field Study (EFS)

The City of Branson will receive an unlimited seat license for Pictometry's Electronic Field Study software for deployment to all city/county agencies in the City of Branson and Taney County, and to any municipality or public school within the City of Branson and Taney County. There are currently thousands of county and city government employees using Pictometry's Electronic Field Study software to make their job more efficient, easier, and save time and money, by reducing field work. Electronic Field Study should meet all of the requirements of the City's and County's users. An overview of the functionality of Electronic Field Study is below.

Pictometry's intuitive EFS software provides users the ability to:

- ✓ Easily extract information from their images
- ✓ Locate images through GIS data
- ✓ See and manage multiple views of each location

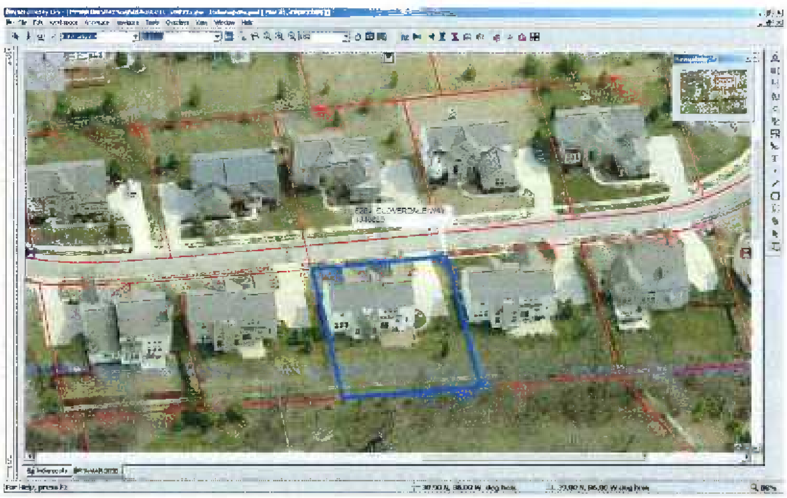
Sample image in EFS showing parcel outline overlay

EFS Features and Functionality

The easy-to use features and functionality of EFS® exceed the everyday needs of most users. Some of the many tools they get with EFS allow them to:

- Measure the bearing of a road and angles of intersecting roads or physical features
- Automatically calculate acreage or square footage of any area or building
- Measure the length, width and Height of any feature in an image
- Click on any feature in an image and get its geo-coordinates and/or elevation
- Click on a location map and have the images for that area appear on the screen
- Move from one adjacent image to another
- Use tools to pan, zoom, rotate and navigate within the images (Walking Man tool)
- Use mouse wheel with Zoom Tool - one-way to zoom in, other to zoom out
- Study a landscape from four compass directions with PentaView
- Utilize and display coordinates from hundreds of different datums

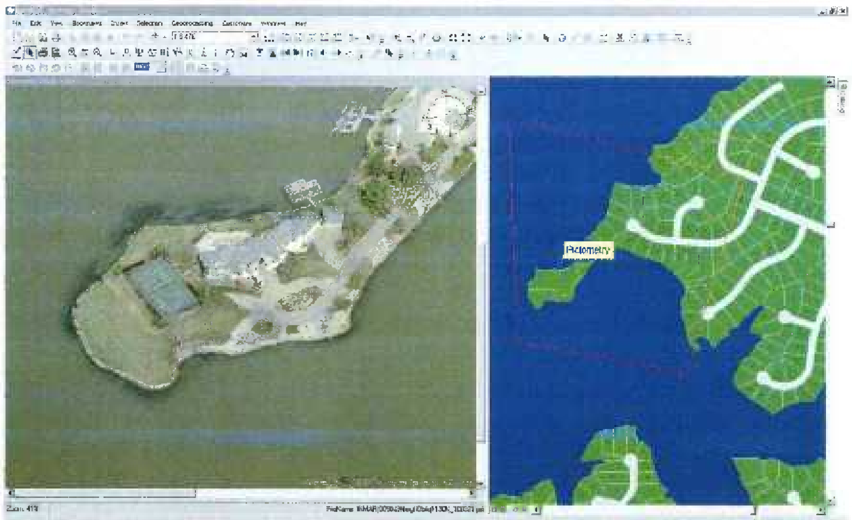
- Establish a "ground plane offset" to more accurately measure and annotate image features that don't touch the ground
- Draw and annotate on the imagery with text lines, circles, lines and icons for powerful presentations and distribution
- Overlay, query, and search for GIS data from shapefiles. Data is displayed as configured text output on the image (i.e. street name)
- Integrate with 3rd party maps, imagery, GIS systems and software packages
- Integrate with CAD system software to automatically display caller's location map
- Extract and display GIS data real-time from an ArcSDE® database. Any data created by EFS users can be written to ArcSDE®
- Label GIS annotation layers with data from text fields; display polygon GIS data with fill colors with selectable levels of opacity; set up GIS Query Tool to "auto-select" the layer to be queried; use EFS with ArcSDE® Version 9.x, ArcMap® 9.x and ArcIMS®



The Electronic Field Study window above shows an oblique image. EFS allows measurement on both ortho and oblique images of feature length, width, height (oblique images only), geo-location, direction and bearing, and automatically calculates an object's area, all on one computer screen.

3.2 ESRI Extensions

As a registered Developer Partner of ESRI, Pictometry's extensions are fully integrated with ArcGIS® /ArcMAP®, ArcIMS®, ArcView®, ArcGIS Server®, and ArcGIS Explorer®. In ESRI's ArcMAP® (versions 9.2, 9.3, and 10), a Pictometry Toolbar is embedded, enabling the GIS user to view the oblique imagery of the area of interest. This enables the users to change directional views, employ the navigation (Walking Man) tool, and take measurements within the image. It also allows any currently displayed feature class to be overlaid on the Pictometry imagery.



Sample screen shot of Pictometry's AccuPlus ArcGIS® v10 ***Extension***

3.3 Web Viewing Software

Pictometry's stand alone Self Hosting Pictometry Online solution (SHPOL) utilizes Pictometry Web Solutions technology and will allow the City of Branson to house its complete image library on its own servers for distribution to its agencies, with full control over its image data. The cost for this application (normally $7,200) has been included at no additional charge in the image capture pricing noted in Section 9 of this response.

The following is an overview of the various components associated with the purchase of the Pictometry Self Hosting package.

<u>Deliverables</u>

Pictometry Online (POL) Web Application

- Turnkey, stand alone java script based web application designed to view, measure, and navigate across the entire image library – no client plug-ins or ActiveX Controls required
- Includes an Administrative interface to manage users, maps and GIS layers

Pictometry Image Library optimized for rapid deployment via the web

- Existing image libraries will be delivered in a sliced/tile-based format designed specifically for use in a web browser environment

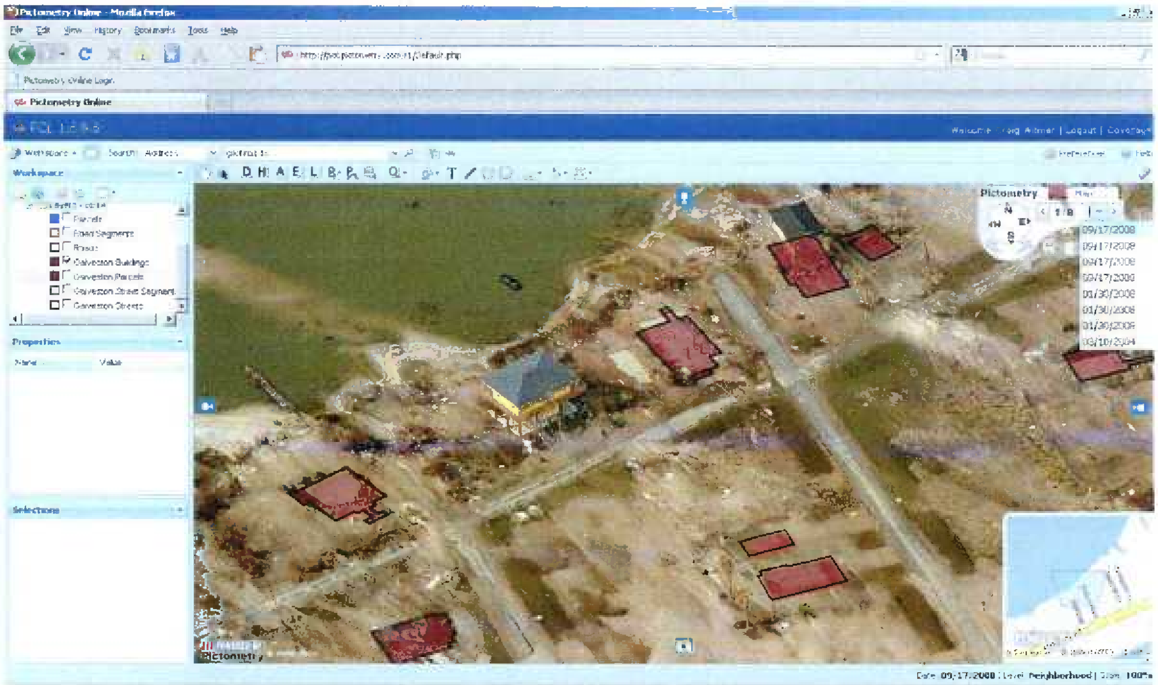
Pictometry Self Hosting PHP server components and PHP extensions

Installation instructions

3rd Party Software (PHP, MySQL, etc.)

Pictometry Image Navigator Engine & SDK

- The underlying technology for Pictometry's web-based solution is included with Self Hosting for the purposes of allowing the City of Branson to create custom applications and integrations.



Sample screen shot of the Pictometry Online web viewing software

4. LiDAR

Pictometry will capture LiDAR data at 1.0 meter point spacing in order to create the Digital Terrain Model (DTM) and the 2-foot contours specified by the City of Branson in its RFP. To achieve this, Pictometry will capture data using its Optech ALTM Gemini LiDAR sensor mounted in a Piper Navajo twin-engine plane. The system is capable of recording surface elevation measurements at up to 167 kHz, and vertical accuracies as great as 5cm. For this project Pictometry will operate its sensor at an altitude of 5900 and a PRF of 100 kHz. In order to ensure full coverage Pictometry will constrain the system to a scan angle of 16.9 degrees and will fly with 30% overlap between flight lines. These capture parameters, in conjunction with the utilization of Pictometry's Trimble R8 and 5700 GPS receivers, will enable production of data to meet and exceed the specifications set forth by the City.

Proposed Capture Parameters

Pictometry Capture System:	Optech ALTM Gemini
Flight Altitude (AGL):	1800 m (5900 ft); nominal
Pulse Repetition Frequency (PRF):	100 kHz
Raw Point Spacing:	1.0 m
Vertical Accuracy:	15 cm – bare earth; 30 cm vegetation and hillside; RMSE
Horizontal Accuracy:	35 cm; RMSE
Returns:	Up to 4 per return
Intensity Records:	Recorded for each return
Coordinate System:	Missouri Central State Plane Coordinate System NAD83/NAVD88, Geoid03 corrected, U.S. Survey feet

Following capture of the data, Pictometry and its subcontractor will utilize several software packages, including Applanix POSPac, Optech's DashMap, Bentley Microstation, the Terrasolid Suite (including TerraScan, TerraMatch, and TerraModeler), and ArCGIS tools to produce the final point cloud and various Terrain Products, including a Digital Elevation Model, Contour Datasets, and other derivative products.

Deliverables

- LiDAR (LAS) Data (see section 3 for description of processes)
  - Tiled LAS files including Return Number and Intensity Attribute for each return
  - Ground points classified via automated methods with manual review and clean-up
    - Duplicate points and 99% of outliers removed
    - 98% of vegetation features removed
    - 99% of buildings removed
  - Deliverables to include 100' buffer beyond contracted area
  - Estimated data size is 10-12 GB per 100 square miles (approximate)
- Terrain Products (see section 4 for full description)
  - DEM/DTM
  - 2-foot Contour Dataset
  - Breaklines
    - Hydro-enforcement breaklines
    - Transportation breaklines
- FGDC compliant metadata
- Raw GPS/INS data and laser range files with supporting information

*Data format (LAS and/or ASCII text), coordinate system (including vertical datum), and tiling scheme to be specified and approved in advance of start of work.

DEM/DTM

ESRI Terrain

The Bare Earth classified data contained in the LAS files will be converted to ESRI Terrain data as a fundamental step toward deriving subsequent bare earth terrain products. Developing the data in this manner will significantly enhance the delivery of data to the City of Branson and provide maximum flexibility for future use, updates, and edits. Standard Hydrographic Breaklines (described below) will be incorporated into all terrain deliverables. Additional breaklines may be developed and incorporated into the terrain at any time.

Digital Elevation Models (DEMs)

The standard DEM deliverable will be assumed to have a 10-foot grid cell size unless otherwise specified by the City of Branson. A Hillshade will be developed from the DEM for visualization and cartographic mapping purposes.

Deliverables:
Collection-wide point data (bare earth only) in ESRI multi-point format
Collection-wide Terrain Data Model (bare earth) in ArcGIS TERRAIN format
Collection-wide Digital Elevation Model (bare earth) in ArcGIS GRID format
Collection-wide Hillshade of the Bare earth DEM in ArcGIS format

Standard Hydrographic Breaklines

Breaklines are linear features that describe a change in the smoothness or continuity of a surface. As part of the baseline effort to create a DEM, limited 3D breaklines will be created for water feature boundaries and wide rivers and incorporate those into the ESRI Terrain data prior to generating any derived products. Hydrographic breaklines will be delineated using the LiDAR data with elevation values assigned from the LiDAR data, using best available aerial photography and the National Hydrography Dataset (NHD) as references.

Water bodies will be defined for the purposes of this task as being larger than 5m across, or greater than one (1) acre. Breaklines delineating the edge of water will be created for all such water bodies. Breaklines will not be developed for streams less than 5m across, also referred to in NHD as "single line streams".

The standard for water bodies in the USGS Specification is 100ft and two (2) acres respectively. "Hydro-flattening", as defined in the USGS Specification, will be completed at a minimum on all water bodies meeting the USGS definition. This task is intended to meet or exceed the requirements for "Hydro-flattening" in the USGS Specification.

For flat and level water bodies (ponds, lakes), a single elevation value will be assigned to the entire polygon and/or to every bank vertex. The entire water surface edge will be at or just below the immediately surrounding terrain. For streams and rivers, breaklines indicating flat and level bank-to-bank conditions (perpendicular to the apparent flow centerline) will be created, with the gradient along the bank to follow the immediately surrounding terrain. Monotonicity will be enforced on breaklines meeting the USGS Specification. Stream and river breaklines delineating the edge of water will stop at road crossings (i.e., culvert locations).

Bare earth LiDAR points that are within the design Nominal Point Spacing (NPS) of a breakline will be re-classified as "Ignored Ground" once the breaklines have been completed. The design NPS of a LiDAR collection is typically between 1 and 2 meters, but may be greater or less depending on the collection specifications of the project.

The identification and prioritization of additional breaklines beyond those minimally described here represents a wide range of expectations and detail depending on specific project/customer needs and intended uses. Most customized uses of breaklines are appropriate for project specific purposes, such as hydraulic modeling, construction site design or transportation engineering. As such, additional breakline development options are offered below. Additional detailed breaklines can be developed and incorporated into the terrain data at any time.

Contour Dataset (2-ft)

The range of available algorithms can result in significant differences in cartographic output quality for the generation of topographic contours. Some methods more accurately represent the point data, but result in a more angular and less cartographically pleasing output. Other methods will smooth the data to varying degrees but produce a much higher quality cartographic output. The customer will be given options, based on demo data, for having their collection area contours created from smoothed data or not-smoothed data.

This task will result in vector (line) data and as such, tiling the data will be required because the vector files can be quite large. The output tiling scheme will correspond to the LiDAR tiles unless the customer requests a different tiling scheme in advance. Final tiled vector data will be seamless and free of edge effects. Elevation attributes will be established to each contour line and identify 10, 20, and 50 ft. index contours, unless otherwise specified by the City of Branson.

Deliverables:
Tiled 2-foot contour files in ESRI Polyline Feature Class format.

5. Timeline

Pictometry proposes to capture the City of Branson's AccuPlus imagery data in the timeframe it seeks, weather and Air Traffic Control permitting. We've projected time frames below for each of the steps in the process, as well as detailing which steps are dependent upon others:

Orthogonal Imagery

Image Capture: Once Katie Neal-Vacca has completed a flight plan, image capture can begin, assuming it is during the City of Branson's preferred capture window. The preferred capture windows are usually when leaf canopies are 30% or less and the ground is not obscured by snow or ice. During a preferred capture window, images will be captured with no cloud obscuration or heavy cloud shadows.

Quality Control Checks: QC checks like GPSs/IMUs, Camera Alignment, Sector Maps, Image Rectification, and dozens more techniques, have been internalized into Pictometry's processes for Image Planning, Image Capture and Image Processing.

Delivery: Pictometry will make best effort to deliver the oblique image library within 90 days of the last image and LiDAR capture. The AccuPlus orthophotography is normally delivered within 180 days after last image capture, weather, air traffic control and contract finalization permitting. All data will be delivered on portable hard drives.

Training: Pictometry's practical training is designed to show users how this new technology can revolutionize the ease with which they do their jobs, while increasing the results they are charged with achieving. That training is structured in the following increments and is included in the cost of the City of Branson's image capture:

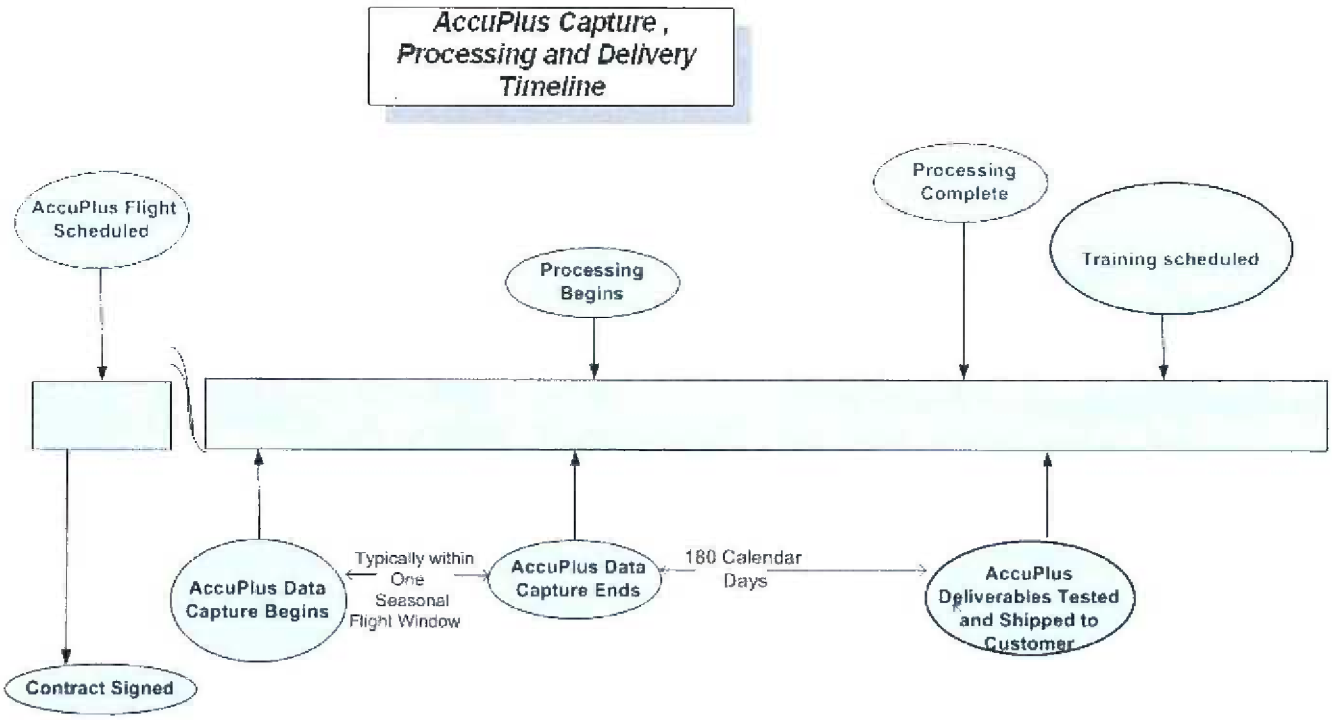
Administrator Training – One 2-3-hour session, via *GoToMeeting*
This training is designed to teach the City of Branson's IT and GIS support staffs how to install, configure and support the Pictometry Image Library and Electronic Field Study software.

End User Orientation Training – Two 2-hour sessions for up to 25 people per session
These sessions (at a City of Branson site) introduces the end users to the myriad of possibilities now open to them through Pictometry's images and their own GIS data.

Advanced User Training (Hands-on) – One 2-3-hour session for one group with up to 10 people
This training provides hands-on interaction with the software to end users chosen by the City of Branson enabling them to learn first-hand the functions covered in the Orientation Session
Web-based Training – The City of Branson's employees can also register at www.pictometry.com for additional, instructor-lead, web-based training at any time for no additional cost

Ongoing Onsite Technical Support – Provided by Christian Stitz, Regional Technical Manager in Missouri.

Telephone Support – Pictometry shall provide up to 10 hours of telephone support, as needed, to those Advanced User participants identified by the City of Branson, during the initial term of the agreement. Hours of support are 8:00 a.m. to 6:00 p.m. EST Mon. thru Fri.



6. Firm Qualifications and Experience

Pictometry, along with its partners, has proven itself a provider of highly accurate orthogonal, oblique and LiDAR imagery in all kinds of geographic areas nationwide. Founded in 1996 and incorporated in 2000, it has been a leader in revolutionizing the GIS landscape by capturing and georeferencing not only the traditional vertical imagery but also low oblique images from four cardinal directions, accurate LiDAR, Color Near Infrared and creating 3D images for its customers. With over 925 U.S. counties as customers and additional commercial collections, Pictometry has amassed imagery in all 50 states, all of the top 133 U.S. cities, and over 90% of the urbanized area census tracts. Pictometry is one of the largest aerial imagery collectors in general with over 130,000,000 vertical and oblique images in its inventory and with 53 planes in its domestic fleet.

While still considered a Small Business for manufacturing, Pictometry has grown to 249 employees, including 40 software and hardware engineers, 60 production and processing technicians, and licensed and certified surveyors, mappers, photogrammetrists, and GIS professionals. The image libraries they produce generally include two grades of products: a visualization product used for

Pictometry International Corp. Information

Firm Name:	**Pictometry International Corp.**
Federal ID Number:	**161595473**
DUNS Number:	**967973769**
GSA Number:	**GS-35F-0801N**
Type of Ownership:	**Privately held Delaware corporation**
Year Established:	**2000**
Website:	**www.pictometry.com**
Contact:	**Howard McGee**
Business Address:	**100 Town Centre Drive, Suite A Rochester, NY 14623**
Phone:	**816-510-9762**
E-Mail:	**howard.mcgee@pictometry.com**

situational awareness by first responders, assessors, and 911 call takers; and a photogrammetric product (AccuPlus) that is used for authoritative purposes. The imagery is generally captured at high resolution, 4" to 6" Ground Sample Distance (GSD), and/or medium resolution, 10" to 12" GSD. Pictometry's normal LiDAR point spacings are 1.0, 0.7, and 0.5 meter.

City of Branson Project Team

We have noted below the bios for the most prominent project team members that will oversee and work on the orthophotography and oblique imagery deliverables for this project. The time commitment they will expend will vary during the different parts of the project. Mike Zoltek will work to ensure that the necessary ground control points and survey get accomplished. Thom Salter is the Director of Photogrammetric Production and it is his team that will process the AccuPlus and LiDAR deliverables for the City of Branson.

As noted on page 3, Katie Neal-Vacca will be assigned to this project for the City of Branson. A Customer Technical Services Representative (CTSR) from Tim Wixom's Training Team will be assigned to train the City of Branson's users on Pictometry's images and software. Ongoing technical support will be provided by Christian Stitz, the Regional Technical Manager for Missouri, and Howard McGee, the District Manager in Missouri. As well, Pictometry's Customer Support Hotline is available during business hours at 888-881-9714 for user support and questions.

Pictometry Bios

Katie Neal-Vacca
Project Manager – Photogrammetric Products
State University of New York at Geneseo
Bachelor of Science in Geological Science

Ms. Neal-Vacca has excelled at several roles within the GIS and Aerial Imaging industries. After graduating from college, she interned at the Monroe County Department of Environmental Services doing GPS and GIS work with outfall inventory for the Storm Water Coalition. She was hired as a Flight Planner at Pictometry International. In that role, she kept detailed records of aircraft deployment, flight plan assignments, the image capture progress, and data receipts on her projects. She was also responsible for generating additional flight plans for any images that needed to be re-captured.

Ms. Neal-Vacca has since been promoted to Project Manager in the Photogrammetric Production Department. She manages development of flight plans for data capture, integrates client geo-spatial data sets, and maintains daily communication with her clients during the image capture process. She works closely with her Customer Support teammates and Pictometry's other internal departments to successfully implement her clients' projects.

Thom Salter, LSP
Director of Photogrammetric Production
St. John Fisher College
BS in Mathematics
Master of Science in Applied Mathematics in Progress at R.I.T.

Mr. Salter is a Virginia Licensed Surveyor Photogrammetrist (SP) and has worked with Pictometry since 2001 in nearly every aspect of its production process and has played an important role in the development of those processes. As Director of Photogrammetric Production, he now works to develop new photogrammetric products and ensures that their standards and procedures meet state certification. He is also responsible for technical coordination of relationships with various business partners, especially as pertains to data integration and compatibility.

Mr. Salter has experience with RTK and post-processed GPS survey techniques, as well as post-processed inertially-aided airborne GPS position and orientation systems. Mr. Salter has led the sensor calibration and alignment efforts at Pictometry and also provided support for the digital camera calibration system to clients. He has technical experience with geospatial products from ESRI, Trimble, Leica, and Applanix, as well as Australis digital camera calibration software. Mr. Salter is currently pursuing a Master of Science in Industrial and Applied Mathematics at the Rochester Institute of Technology, Rochester, NY. He is a Licensed Surveyor Photogrammetrist in Virginia - #408000140.

Michael J. Zoltek, LS, CFedS, GISP
VP Surveying& Mapping
Bachelor of Science in Surveying and Mapping
University of Florida

Mr. Zoltek has been a Licensed Professional Surveyor since 1997 and currently holds active Surveying registrations in Florida, Georgia, Alabama, Idaho, South Dakota, Texas, North Dakota, West Virginia, Mississippi, Louisiana and South Carolina. He is also a Certified Federal Surveyor (CFedS) and a Geographic Information Systems Professional (GISP). Mr. Zoltek is experienced in the coordination and supervision of large scale Photogrammetric and LiDAR projects including the establishment and approval of the technical procedures utilized in the collection, processing and certification of data. He is experienced in a wide variety of public and private sector projects and has extensive experience working in various districts of the Florida Department of Transportation. Mr. Zoltek has served as an expert witness on Boundary related litigation cases in Florida and has been a guest lecturer at both the University of Florida and Troy University Geomatics Programs. Mr. Zoltek has also been a presenter of professional technical seminars at the Rocket City Geospatial Symposium at Troy University, The Surveying and Mapping Society of Georgia (SAMSOG) Summer Conference, at Avatech Solutions' in-house training seminars in Virginia Beach, VA and Las Vegas, NV and also at Pictometry's FutureView Conferences and various State Pictometry User Groups (PUGs). Mr. Zoltek is also a serving member of the ASPRS Commercial Product Guidelines Committee.

Tim Wixom
Training Manager
Customer Technical Services
Roberts Wesleyan College
Bachelor of Science in Organizational Management

Mr. Wixom spent 25 years in the Public Safety sector finally retiring as a 911 Director of a large local municipality. His county was one of Pictometry's first customers and Mr. Wixom one of its first end users. In his new role as the Training Manager in Pictometry's Customer Technical Services (CTS) division, Mr. Wixom is responsible for the management, mentoring and continuing education of a staff of ten CTS trainers who travel to our customers' sites for hands-on or lecture-style training. He oversees the on-line web-based training provided by the company, and is responsible for the development and updating of all training materials. His years of corporate and municipal experience and extensive technical background give him the bandwidth to work closely with our customers to ensure they receive the top level training and support they need.

7. Project References

AccuPlus Orthophotography and Oblique Imagery Project References

<u>City of Philadelphia, PA</u>
Brian K Ivey, GIS Manager
1234 Market St., Suite 1500
Philadelphia, PA 19107
Phone/Fax: 215-686-8287 / 215-686-8143
E-Mail: brian.ivey@phila.gov
<u>Departments Using Pictometry's Services:</u> Planning, Emergency Management, Assessment, Police, Fire, Licensing and Inspection, Philadelphia Gas Works
<u>Additional Applications</u>: LiDAR, AccuPlus, EFS Software, 3D, ChangeFindr, ArcGIS and ArcSDE

Pictometry Customer: Since 2003
Land Area: 191 mi^2
LiDAR Land Area: 163 mi^2
LiDAR Point Spacing: 0.7 meter for 1-foot contours

Imagery Products: Community Level: 191 mi^2 of 3 – way oblique/ortho imagery
Neighborhood Level: 191 mi^2 5 – way oblique/ortho imagery
Start/Stop Dates: Jan-April, 2008
LiDAR Value: $ 34,230
Total Contract Value: $301,383

Los Angeles County, CA
Mark Greninger, Chief Geographic Information Officer
Chief Information Office
World Trade Center
350 S. Figueroa St, Suite 188
Los Angeles, CA 90071
Phone: (213) 253-5624
E-Mail: mgreninger@cio.lacounty.gov

Departments Using Pictometry's Services:
Assessment and GIS Departments
Additional Applications: EFS software, ArcIMS deployment, ArcSDE support, AccuPlus
Pictometry Customer Since 2004
Land area: 4,216 mi^{2*}
Products: Community Level: 4,216 mi^2 of 3 – way oblique/ortho imagery
Neighborhood Level: 3,167 mi^2 5 – way oblique/ortho imagery
Start/Stop Dates: March, 2008
Contract Value: $1,572,767

**This project represents what is believed to be the single largest orthogonal imagery project in history, based on the number of source frames; nearly 300,000 frames were triangulated and ortho-rectified to create the final ortho mosaic.*

Weber, UT
Josh Jones, Sr. GIS Project Coordinator
Ogden City GIS
2549 Washington Blvd
Ogden, UT 84401
Phone: (801) 629-8757
E-Mail: JoshJones@ci.ogden.ut.us

Pictometry Services: LiDAR (Contours, Hillshade and Slopes), Oblique and Orthogonal Imagery, EFS Software
Departments Using Pictometry's Services: GIS, Business & Community Development, Planning, Engineering

Pictometry Customer: Since 2006
Land Area: 632 sq. miles
LiDAR Land Area: 51 sq. miles
LiDAR Point Spacing: 1.0 point spacing
Start/Delivery Dates: Fall, 2009
LiDAR Value: $40,730

Weber, UT Commendation:

I received the AccuPlus Ortho mosaic yesterday and had a chance to do a little quality checking this morning. I just wanted to say that this image is the most accurate and well-corrected flight we have ever purchased. In my spot checks, I did not observe any pixels off by more than 6" and the majority was within 4" or 1 pixel of their true location based on Ogden city survey data. The care that was taken to correct building layover was excellent and we have had no other vendor perform so well in this correction. We received a wonderfully accurate ortho and only wish that Ogden would have been more beautiful at the time of the flight so the color would have been better, but hey, accuracy is accuracy and leaf off conditions are as good as could be expected. Thanks for providing such an excellent product. It speaks very well of your team and of your company.

Josh Jones, Ogden City GIS
JoshJones@ci.ogden.ut.us
September 16, 2010

8. Certificate of Insurance

Pictometry has a Certificate of Insurance on file noting Branson, MO as the Certificate Holder for this project.

9. Cost Proposal

Option 1*

79 sectors of 12-inch GSD Standard 2-way Oblique imagery..$ 3,555.00
79 sectors of 4-inch GSD AccuPlus 5-way Orthogonal and Oblique Imagery......................$50,955.00
57 square miles of LiDAR at 1.0 meter point spacing necessary for the creation of DEM,
Contours and breaklines..$11,970.00
Total...$66,480.00

*Ortho and Oblique imagery would be delivered for the full 79 square mile (sector) flight grid. Coverage area is depicted on Pictometry's map below.

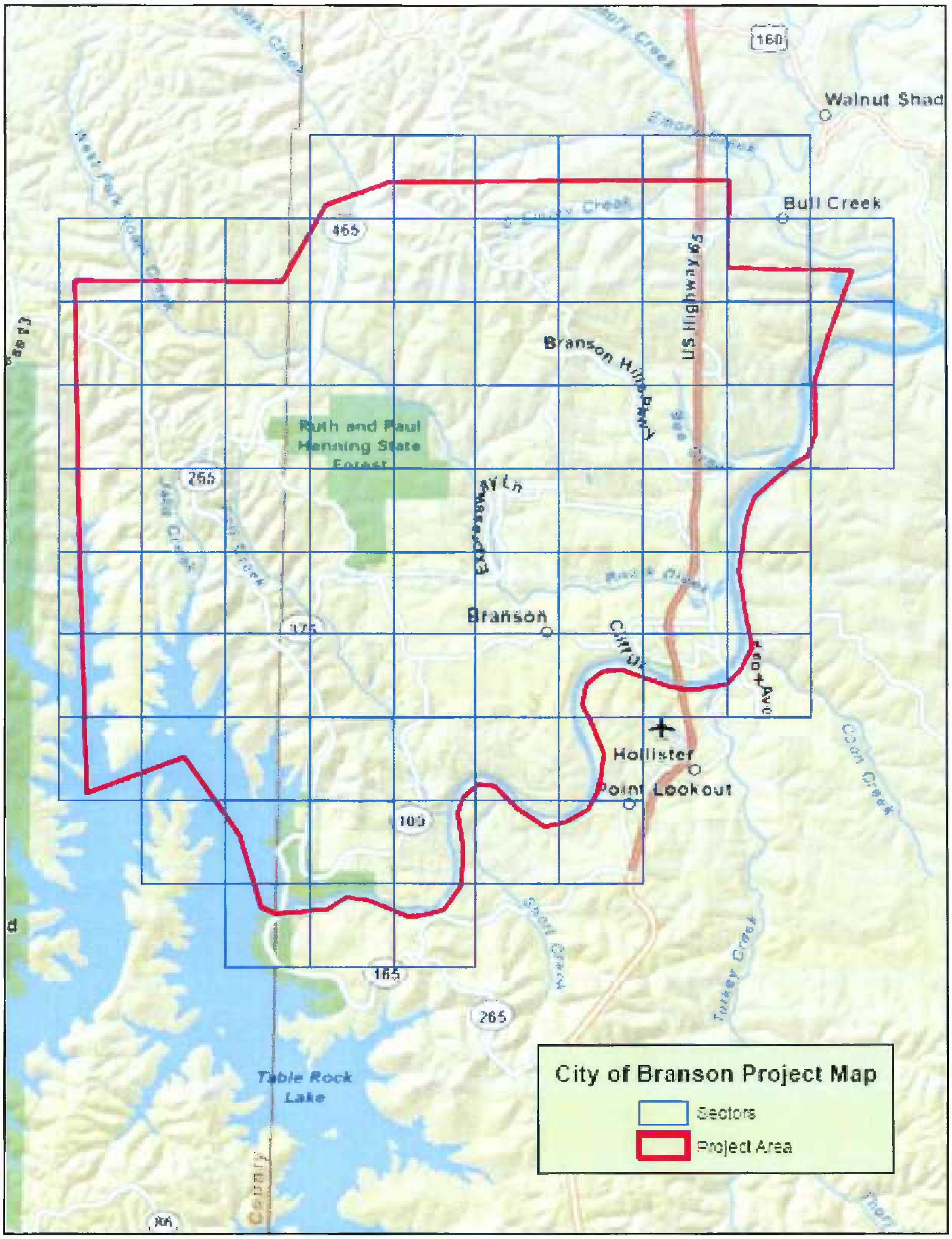
Option 2**

57 square miles of 12-inch GSD Standard 2-way Oblique imagery.................................$ 2,565.00
57 square miles of 4-inch AccuPlus 5-way Orthogonal and Oblique Imagery....................$36,765.00
57 square miles of LiDAR at 1.0 meter point spacing necessary for the creation of DEM,
Contours and breaklines..$11,970.00
Total...$51,300.00

**Ortho and Oblique imagery would be delivered for the 57 square miles of the City of Branson's project area. Coverage area is depicted on Pictometry's map below.

Pricing above is guaranteed until April 26, 2011.

10. Sector Map

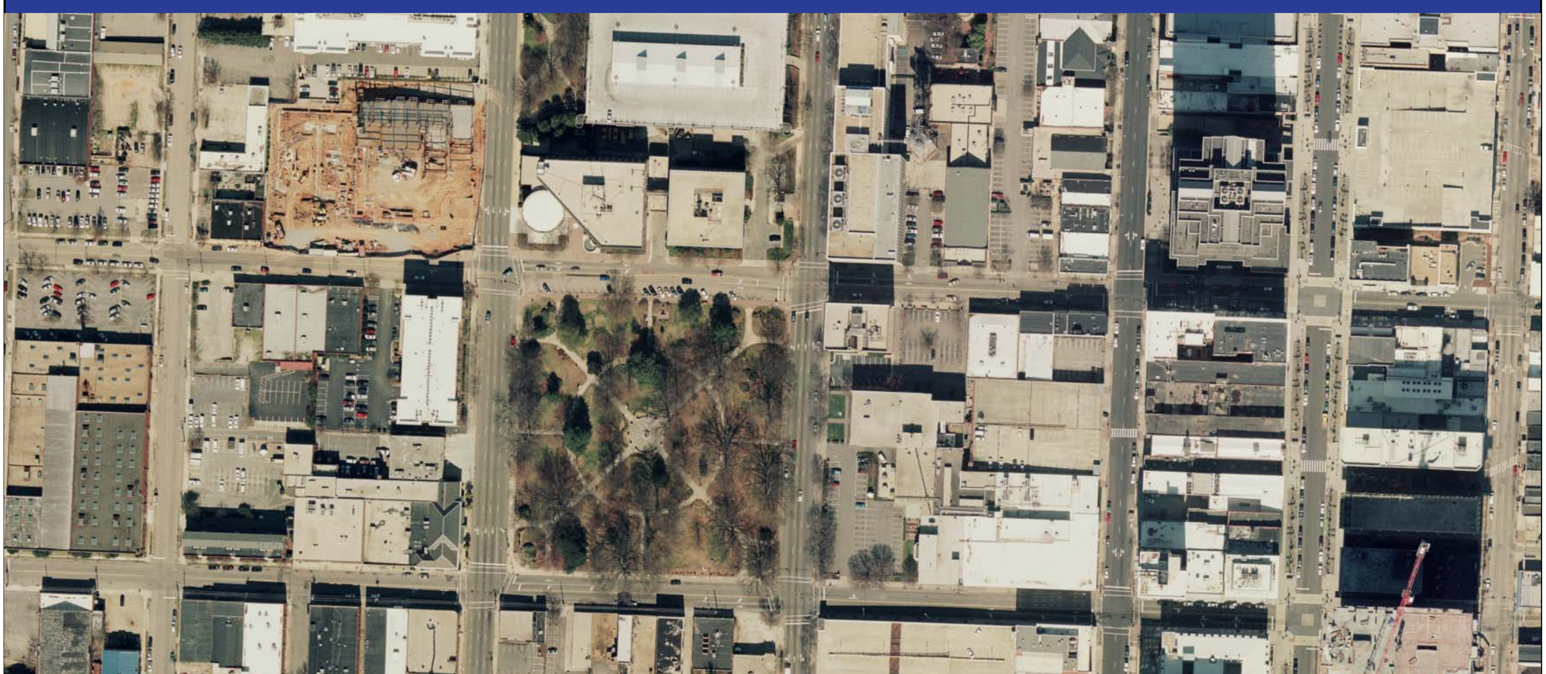


Our Proposal for

Digital Orthophotography and Oblique Imagery

Submitted by

Surdex Corporation and Pictometry



January 2011

January 30, 2011

Curtis J. Copeland, G.I.S. Coordinator
110 W. Maddux Street, Suite 310
Branson, Missouri 65616

Dear Mr. Copeland,

On behalf of the team at Surdex Corp., I am pleased to submit our statement of qualification to the City of Branson for the 2011 Digital Orthophoto project. Since 1954 Surdex has served clients across the United States continuously providing accurate and timely photogrammetric services. These services include: digital orthophotography; planimetric and topographic mapping; and LiDAR.

Surdex has exceptional technical resources including three Intergraph Digital Mapping Cameras (DMCs) and our fleet of eight aircraft. Access to multiple internal resources, including personnel that has assisted with the City of Branson's base mapping and GIS since the 1990s, along with a proven project management approach and methodology ensure that the critical acquisition phase and production of the project will be performed on time. Timely and effective communication with you is delivered by both the Surdex project manager and our web-based status system. This access to information and personnel are just part of our drive to deliver on your complete customer satisfaction.

We appreciate your consideration of Surdex for such an important project and we are confident that our technical capabilities, resources and flexibility will deliver unmatched value to The City of Branson. In keeping with the 20 page proposal limitation, the information provided is relatively "high level." If you should have any additional questions, please do not hesitate to contact me at (636) 532-4418 or by email at DBullington@surdex.com.
Best regards,

Dave Bullington
Business Development Representative
Surdex Corporation

Introduction and Executive Summary

Our Team

Surdex Corporation is pleased to provide our qualifications to The City of Branson, Mo., in response to the RFQ for Digital Orthophotos. Our Team consists of Surdex Corporation of Chesterfield, Mo, and Pictometry of Rochester, N.Y. Surdex will be the prime contractor and will be responsible for nearly all phases of the project. Pictometry will be responsible for the acquisition of and delivery of the oblique imagery services. ***Only US labor, by Surdex and Pictometry will be utilized on this project.***

Surdex brings over a half century of photogrammetric mapping, boasting clients in the federal, state, and local government sectors as well as private engineering, energy, defense mapping, and Homeland Security. We have performed mapping projects all over the United States, Canada, and Mexico. Our services include surveying, aerial digital and film photography acquisition, aerial LiDAR acquisition, planimetric mapping, topographic mapping, digital orthophotos and GIS services.

Surdex is pleased to have Pictometry International Corp. on its team to provide the oblique image services if requested by The City of Branson. Pictometry has been the leading provider of geo-referenced aerial image libraries and related software for over 10 years. With over 850 U.S. counties as customers, Pictometry has amassed imagery in all 50 states, all of the top 133 U.S. cities, and over 90 percent of the urbanized area census tracts. Pictometry captures this imagery with a fleet of 53 aircraft, outfitted with Pictometry's patented oblique capture technology, and processes this data at its Rochester-based facilities. 100 percent of all Pictometry imagery is processed in the United States. Pictomerty's suite of products include Oblique imagery in four different ground sample distances, LiDAR, Infrared, Critical 360º (an infrastructure mapping product), 3D and Change Detection.

There are compelling reasons why The City of Branson should select our Team for this important project:

1. Surdex is one of the largest and most respected photogrammetric mapping companies in the United States. We have a strong reputation for getting projects done to the highest quality, accuracy, and performance standards.
2. Surdex has more than sufficient image acquisition and production capacity to handle this project. Our three Intergraph Digital Mapping Cameras (DMC) and one Vexel Ultracam XpWA represents one of the largest single installations of digital camera systems in North America. Surdex first used digital imaging technology in 2005 and has acquired and processed over 600,000 images to date.
3. Surdex's proprietary image processing approach produces digital orthophotos of the highest accuracy, quality, and fidelity. We are considered by our peers as having one of the most progressive R&D activities in the profession.
4. Our image quality process engages our clients in the determination of desirable image quality, color, tone, and balance – *prior* to the start of production activities.
5. Our team member, Pictomerty, providing high quality oblique imagery
6. Providing all required services *and* optional LiDAR within budget

Our project management staff is committed to providing information and following up with strong communication. The City of Branson will know project status as well as Surdex's own staff. Knowing that some challenges will occur on every project, our issue-resolution process is based on honesty and openness and will engage The City of Branson in the process.

The combined local knowledge of Surdex and Pictometry will ensure communication and project execution. All companies are active in state and regional conferences and meetings and are well aware of the terrain and challenges of the project.

Surdex's proprietary image processing and production software not only provides products of the highest possible quality, but ensures project schedules can be met. A foundation of our approach is the use of reference images provided as samples to our clients shortly after acquisition starts and well before production begins. We will work with The City of Branson to determine the desired image color, tone, balance, etc. very early in the process. Image processing of all acquired imagery will then target these characteristics, ensuring that the final product is to the liking of the City. This approach helps ensure adherence to schedule and reduces costly and time-consuming re-work.

Experience and Technical Competence

Surdex has a long history of providing high quality orthophoto services to federal, state, county and municipal organizations. In August of 2009, Randy Mayden joined Surdex as a member of the Business Development/Technical Support Staff. Randy has intimate knowledge of the Branson base mapping program being involved since the 1990's. Randy was instrumental in analyzing previous map updates and designing a program to provide consistency of the map features and ESRI schema. Randy's knowledge of municipal mapping, specifically the City of Branson Program, coupled with the superior capabilities of Surdex, will ensure that the City of Branson receives services tailored to the needs of the City.

As stated previously, Surdex has an extremely robust R&D department that has spent countless hours developing highly efficient applications to improve the visual (radiometric) qualities of our orthophoto services and increase efficiency and quality of our mosaicking process. Additionally, Surdex's ortho process, from capture to delivery, uses the full 12-bit data collected by the DMC digital image sensor to retain the full depth of the data collected. If 8-bit data is required as a deliverable, the down-sampling of the data is completed just prior to delivery.

Project Staff Assignments

The following table offers a synopsis of these individuals and their certification numbers. Our senior key staff has been with us, on average, for 18 years.

ASPRS Certified Photogrammetrists					
Name	Years Experience	Certification/ Registration	Name	Years Experience	Certification/ Registration
• Dave Beattie	10	2009, #1417	• Scott Merritt	18	2010, #1444
• John Boeding	22	1997, #1043	• Charles Meyers	11	2007, #1329
• Tim Bohn	14	2002, #1207	• Karl North	16	1998, #1122
• E. R. Hoffmann, Jr.	33	1993, #920	• Cornell Rowan	24	2009, #1055
• Randall K. Hoffmann	35	1993, #933	• Larry Stolte	22	1998, #1067
• Steve Kasten	25	1997, #1040	• Wade Williams	13	2006, #1290
• Jay McLeester	23	1988, #736			

As a client of Surdex Corporation, The City of Branson will have the resources of our staff at its disposal. Should matters arise that need the expertise of anyone on our staff, your Project Manager will be able to pull in the resource that is best suited to solve the issue. Following is a table depicting your project team, along with contact information.

City of Branson, Missouri

Cornell Rowan
Project Manager
14 years experience
B.S. Cartography
cornellr@surdex.com; (636) 368-4460

Jon Noirfalise
Flight Manager-Chief Pilot
4 years experience
B.S., Business Administration
jonathann@surdex.com; (636) 368-4512

Pilots

Kevin Eichelberger
Sensor Operator Manager
4 years experience
Defense Information School
kevine@surdex.com; (636) 368-4514

Sensor Operators

Steve Kasten
Vice President of Survey
25 years experience
M.S., B.S.
stevek@surdex.com; (636) 368-4428

Surveyors

Larry Stolte, CP
Aerial Triangulation Manager
16 years experience
larrys@surdex.com; (636) 368-4454

AT Technicians

Randy Hoffmann, CP
Stereo Compilation Manager
30 years experience
B.S. Forestry
randyh@surdex.com; (636) 368-4440

Stereo Compilation Technicians

Brad Barker, CP
Cartographic Finishing Manager
11 years experience
B.S, Cartography
bradb@surdex.com; (636) 368-4444

Finishing Technicians

Adam Hoffmann, CP
Orthophotography Manager
4 years
B.S. Graphic Design
adamh@surdex.com; (636) 368-4448

Orthophoto Technicians

Pictometry

Chad Rhinewald
Project Manager

Pat Blankford
Vice President of Production

Tim Harrington
Vice President of Processing

Ability to meet Time and Schedule

	Mar	Apr	May	Jun
Acquisition (two weeks)				
Image Processing (one weeks)				
Aerial Triangulation (two weeks)				
Compilation (six weeks)				
Digital Orthophotography (one week)				

Past Performance

A prime example of our excellent past performance is a project we did for the Mid-America Regional Council (MARC) in 2010. This project was awarded on a competitive basis to Surdex in 2010. Image acquisition was done using the companies DMC large-format digital cameras. Even with the requirement for small areas at 1' resolution, Surdex elected to fly the entire area at 6" resolution. Leaf-off acquisition of ~11,300 exposures was completed within only a few days. We have included contact information for MARC in the References section.

Location of Office

The services for this proposal will be provided from Surdex's St. Louis office located at 520 Spirit of St. Louis Boulevard, Chesterfield, Missouri, 63005.

Cost Breakdown

Service	Price
Digital Orthophotography	$51,570
LiDAR and Contour Mapping	$23,100
Pictometry Oblique Imagery	$35,155
Total	$109,825

References

Surdex References

Mid-America Regional Council (MARC) (2010)	
Project Description: Surdex created natural color digital orthophotos covering ~2,500 square miles for the Kansas City metropolitan region at 6" resolution and 1' resolution. Data was delivered and reviewed by: Clay, Jackson and Platte County in Missouri; Wyandotte and Johnson counties in Kansas; and the cities of Kansas City and Raymore, Missouri. Each entity received data for the respective region and the entire data set was delivered to MARC. Surdex utilized client-provided DEM data and updated the surface after delivery. All acquisition was performed using Surdex's Z/I Imaging Digital Mapping Cameras (DMC).	
Client: MARC 600 Broadway, Suite 300 Kansas City, MO 64105-1536	**Contact:** Brian Parr tel: (816) 474-4240
Project Cost: $313,309	**Project Completion:** 2010

Pictometry References

Springfield, Missouri	City of Indianapolis & Marion County, Indiana
Mike Fonner, GIS Manager 840 Booneville Ave. Springfield, MO 65802 Phone: (417) 864-1942 E-Mail: mike_fonner@ci.springfield.mo.us	Chuck Carufel, GIS Director, City of Indianapolis 200 E. Washington St. Indianapolis, IN 46204 Phone: (317) 327-3100 E-Mail: ccarufel@indygov.org
Departments Using Pictometry's Services: GIS Department, Planning, Public Safety, Public Works	Departments Using Pictometry's Services: Public Safety, Public Works, Property Appraisal, Planning, the Prosecutor's Office in Indianapolis
Additional Applications: EFS, ArcMAP®, ArcSDE®, E-911 Integration	Additional Applications: EFS, ArcSDE®, ArcMAP® and ArcIMS®
Pictometry Customer: Since 2008	Pictometry Customer: Since 2004
Land Area: 1323 mi^2	Land Area: 446 sq. miles
Products: 1323 mi^2 3–way oblique images 388 mi^2 5–way oblique images	446 mi^2 3–way oblique images 446 mi^2 5–way oblique images
Start/Stop Dates: Jun 2008 – Present	March 2006 – June 2006 (2^{nd} Flight)
Contract Value: $196,000.00	$166,182

How Surdex will Complete the Project

Surdex is completely familiar with the objectives and technicial requirements of a project of this scope and size. We can summarize our view of this project as follows:

1. Complete digital imagery acquisition in leaf off conditions using a ***large format*** digital camera including manufacture certification by the USGS.
2. Existing ground control points will be used on the project where applicable. Approximately 57 square miles of color digital orthophotos will be provided.
3. Existing DTM and DEM will be reviewed for accuracy and updated new 2-foot contours in areas as specified, using both LiDAR and digital imagery will be produced and delivered back to The City of Branson.

4. Imagery data will be delivered as 24-bit, 3 band RGB TIFF with world file. Final delivery of all products by October 1, 2011. Unless alternate accuracies are required, all deliverable products will have accuracies that meet or exceed previous orthophotos.
5. Oblique imagery services provided by Pictometry including 4" standard view and 12'. Optional LiDAR collection and processing. Optional deliverables include all point files, intensity images, bare earth and updated 2-foot contours.

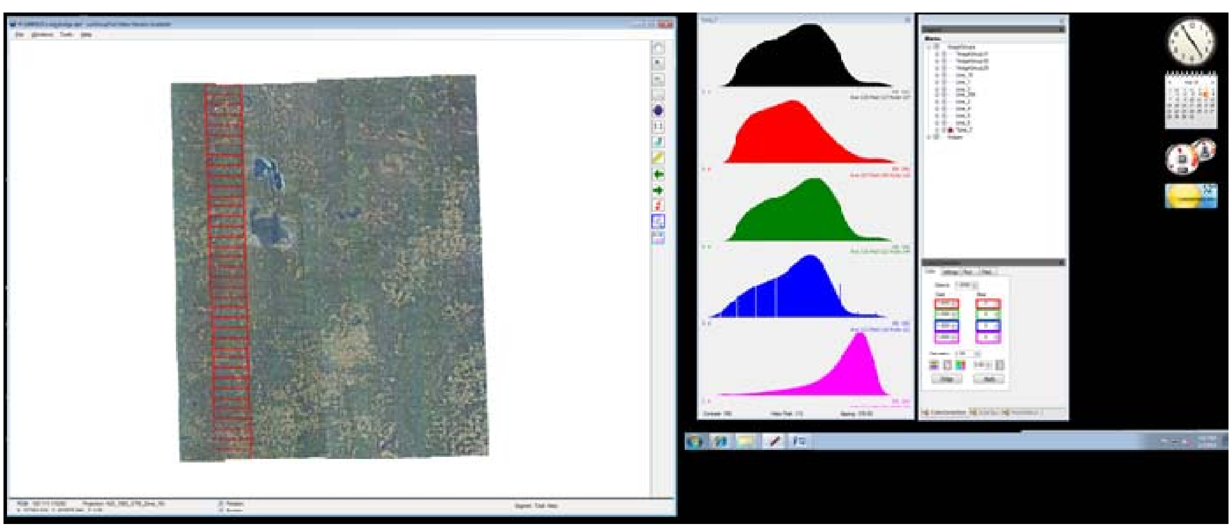
Understanding that the QC process and acceptance by the client can be demanding and time consuming, Surdex has developed our Client Product Acceptance Tool (CPAT), an online QC tool available to all of our clients. This tool allows the client to view, redline, comment and accept the ortho data online eliminating the need for numerous shipments of data and coordination of QC findings. We have provided an examination of Surdex's orthophoto process, from acquisition to delivery, in the Orthophoto Process section.

Surdex's unique services

One process that makes Surdex's ortho services unique is Surdex's proprietary Grouping Tool (GT). This tool is used immediately after the initial post processing of the raw aerial imagery providing radiometric balancing of the entire aerial imagery prior to the analytical triangulation and orthorectification process. This methodology allows Surdex *and the client* to agree on the final characteristics of the image prior to final processing. With this process, Surdex clients are assured that the final ortho data matches the sample data approved shortly after image acquisition. Therefore, costly and time-consuming rework, which creates delays and missed schedules, is avoided.

The Grouping Tool is responsible for over 90 percent of the final product quality and "colorimetry" (color, tone, balance, contrast, etc.). In other words, the appearance of the imagery displayed in GT is nearly identical to that of the final product—in advance of use within the production chain. Only minor adjustment may be made during final mosaicking in isolated areas. All calculations in the image processing chain are carried out at 12 bits/pixel (bpp) depth and using all four bands (R, G, B, NIR), thus preserving the complete dynamic range of the data.

Surdex utilizes imagery metrics for color, brightness, contrast, clipping, neutrality, etc. based on values adopted by the USDA NAIP effort. However, these are only guide values for the technicians and are subject to change at the client's discretion before the colorimetry for a project is locked down.



Grouping Tool Functionality. *Dual-screen operation showing grouping selection and 5-component histogram tool (luminosity, red, green, blue, near infrared).*

Surdex R&D completed the first version of Grouping Tool in 2006 and has continuously improved the tool and interface. GT now incorporates all orthorectification, final balancing, and mosaicking in the same interface. The advantages of this proprietary software are:

- Common workflow for all types of digital images (DMC, UCXp/WA, scanned film, etc.)
- Archiving of digital negatives —12 bpp by 4-band files provides as near an original image as practical
- Database managed workflow—each image is tracked with full metadata and image metrics and is under version control. Opportunity to improve on the capabilities and efficiencies without relying upon priorities of third-party software.

Another unique service provided by Surdex is the delivery of the seamlines used to mosaic the individual orthophotos. At Surdex, we understand that the client quality control process can at times be cumbersome and time consuming. With this in mind, Surdex decided to deliver seamlines data, where the greatest possibility of QC issues are present, as vector files to guide client inspection in the QC process.

The two services as described, initial color balancing and seamline inspection, remove the majority of the QC problems typically encountered in an orthophoto product.

Online Client Quality Control

Surdex's Client Product Acceptance Tool (CPAT) will be hosted on a project-specific portion of our website for use by The City of Branson. CPAT is instantiated as a map service built over the ESRI ImageServer product with the interface developed in the Microsoft Silverlight development environment. The SQL Server relational database underlies the application and serves to track call-outs and their resolution.

This results in cost and time savings by reducing delivery and re-delivery logistics, time, and storage. CPAT will be available to The City of Branson in addition to the traditional delivery of orthophoto data and the traditional QC approach.

Highlights of CPAT include:

- Selectable graphic overlays of delivery tiles, including status (acceptance, rejection, ready-for-re-inspection, etc.)
- Display of seamline data for QC (Since most of the errors caught during QC are related to seamlines, this provides a ready means for The City of Branson to examine this important data set.)
- The fast imagery roam and zoom capability of ImageServer, hosted on the Surdex side, supports quick review, independent of a client's server capability and storage
- Provided as a web service, our clients can introduce vector layers for display—such as a client-owned bridge layer from a GIS to determine whether bridges are properly dealt with on the orthophotos
- Supports multiple inspectors on the client side. For example, inspectors can be assigned explicit areas of interest (AOIs) to work independent from one another, but in parallel
- Ability to generate textual and graphical reports to assess QC status.

Professional Resources

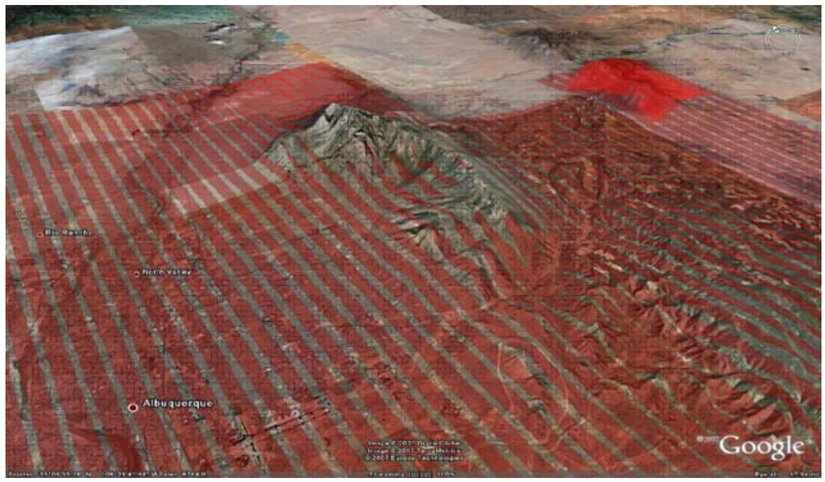
At Surdex, our success has hinged on hiring—and retaining—the most skilled professionals in the industry, and balancing all resources to achieve our clients' scheduling and quality requirements. When The City of Branson selects Surdex, it will select a firm with a highly-skilled, experienced staff that excellently coordinates services with the best resources the industry has to offer. Following is some additional information about Surdex's staff.

- Surdex's staff has impeccable educational credentials, with many members having masters degrees in earth sciences, computer sciences, mathematics, geodesy and photogrammetry.
- The full time staff of Surdex includes three registered land surveyors. Combined, these individuals have more than 60 years of industry experience.
- Surdex Corporation has 12 photogrammetrists certified with the American Society of Photogrammetry and Remote Sensing.

Surdex Orthophoto Process

Flight Planning

The flight plans are developed by Surdex's chief pilot and are approved by the project manager, a certified photogrammetrist. Surdex uses the IGI Plan flight planning software for DMC planning, which utilizes an elevation model to rigorously check for adequate forward and sidelap coverage. Flights are planned against the buffered coverage for each seasonal window portion of applicable project areas. A flight designer can iterate with the software to achieve not only efficient acquisition but also guaranteed coverage of the entire area.



Visualization of IGI Plan Design

All flight plans incorporate the following:

- There will be stereoscopic coverage of the buffered project.
- A forward overlap of 60 percent and a sidelap of at least 30 percent will be used for north-south flight lines.
- Project areas with a dominant east-to-west layout may be designed and flown east-to-west. These, or any diagonal flights, will be flown at 40 percent sidelap to minimize the effect of bi-directional sun angle reflectance.
- Each flight line will have at least two additional models (four exposures) beyond the required extent of coverage. This ensures that aircraft entering and leaving the line do not deviate from the flight path.
- Along the sides of the project, at least half of the stereomodel will fall outside of the project bounds.
- In urban areas, the flight design will incorporate 80 percent forward lap and 60 percent sidelap to aid ortho technicians in reducing the effect of building lean.
- The DMC uses a multiplier of 10,000. That is, to achieve a 1′ pixel, the nominal flying height will be 10,000′ above ground level (AGL). For 0.33′ (4″) pixels, a flying height of ~3,300′ AGL will be used.
- If line breaks are required, each line segment will overlap at least three exposures.

The preliminary flight design for the 2011 project is portrayed in the following graphic. The flight statistics for the 4″ coverage area is in the following table.

Resolution	Exposures	Flight lines	Hours of Acquisition	Estimated Days
4” (3,300’ AGL)	662	17	4	1

Acquisition

The objective is to acquire the imagery in the least amount of time possible, which results in consistent scene appearance and the highest possible product quality. Surdex will monitor weather conditions and forecasts as the acquisition window approaches. When suitable conditions are expected, Surdex will advance the priority of the City of Branson acquisition in anticipation of favorable conditions. Surdex continuously monitors the location of our fleet of aircraft providing rapid deployment of the nearest available aircraft and crew.

Surdex’s Aircraft and Hanger. *Surdex’s flight maintenance group inspects, maintains, and repairs our fleet of aircraft to FAA specifications and standards. This means less downtime of our aircraft and the ability to mobilize anywhere in North America in a matter of hours.*

Surdex will fully coordinate air operations with The City of Branson, providing notification when the aircraft is on site and when it leaves. Daily acquisition status in graphical form, complete with inspection updates and possible re-flight designation, will be supplied to The City of Branson by email and/or via a dedicate web site.

Because acquisition is the most critical phase of the project, Surdex incorporates:

- Daily updates of flight plans by fax, e-mail, or ftp from Surdex’s FlightDB Same-day shipment of raw imagery data and ABGPS/IMU data to corporate office
- Same-day update of flight logs (exposures acquired) by fax or e-mail to Surdex
- Automatic issuance of the Daily Progress Report will be sent via e-mail by the FlightDB.

Unlike most acquisition providers, Surdex employs the manual exposure value method. Once the aircraft is at the capture altitude, light meter readings are taken over representative terrain. The exposure values are locked and the crew proceeds to the first line. During flight lines, operators monitor the meter’s measured exposure value beside the current locked value. If the locked value differs from the meter’s average indicated value by more than 1/3rd f-stop, the operator corrects the locked value. This exposure metering method is superior to the automatic approach because it does not respond to small bright or dark areas, common to the Lakes area and deep ravines associated to the Ozarks topography, in the scene that would bias the exposure at the expense of the larger area.

Image Inspection

Imagery inspection is based on 100 percent inspection—each and every image is viewed and graded. Inspection will be conducted for digital images against the acquisition requirements of:

- Within the project season window
- At least 30º sun angle
- Ground is free from standing water (other than natural or man-made ponds and lakes)
- Free of clouds and cloud shadows
- Ground is free from streams which have overflowed their banks
- Ground is not wet ground which obscures field, soil, or crop lines
- Image tilt and crab of less than 5° over the entire project.

Inspection is not limited to conditions, but also addresses the following:

- Camera misfires
- Specular reflection—noted in the database for use by the ortho technicians
- Image artifacts.

Image Processing

Due to the complexity of today's digital sensors, Surdex employs a systematic and scientific approach (established and well documented) to the initial image processing. This approach allows highly skilled technicians to view the entire Branson image dataset and apply radiometric corrections throughout. In brief, all data is viewed and color corrections applied to Gamma (brightness), solar, and dodging or luminosity (the intensity of the red, green and blue channels). Due to these corrections being made in the native 12-bit depth, precise balance is achieved throughout the entire area ensuring a consistent image match on all ortho tiles. It is important to note that these corrections are applied prior to any further processing.

After this initial balance, several "reference images" will be sent to the City to analyze and provide comments and/or approval. Minor adjustments agreed to, will be applied establishing the final radiometry to be delivered. This process eliminates any "surprises" upon delivery of the final ortho images. Although many firms provide sample image data that may (or may not) match the final orthos, the Surdex process has been developed to ensure this outcome.

Ground Control Survey

To assure consistency with previous projects, Surdex will work with The City of Branson to utilize any existing ground control from previous projects. These points can consist of targeted and/or photo identifiable points. If required, Surdex has the ability to develop new ground control points through GPS surveying techniques and assure that these surveys are tied into any existing control networks. Surdex's Survey Department includes personnel registered as professional land surveyors with the majority of their workload involving the design and establishment of ground control and targets for photogrammetric projects. If additional survey is required the ground control survey design will be performed or managed under the direct supervision of a Registered Land Surveyor.

Analytical Triangulation

Surdex will apply several control methods to the imagery to ensure that the imagery is controlled both horizontally and vertically. Surdex will capture ABGPS and IMU data during acquisition and incorporate existing ground control into the analytical triangulation process. It is vitally important that ground control be used in the process. Even though ABGPS and IMU technologies are dependable and accurate, confirmation, verification and precise adjustment of the GPS bias are instrumental to ensure final accuracy and reliability. This is even more significant when the project, such as the City's, includes production of *any* surface data. This important step will establish the vertical accuracy for: 1) possible DTM update via photogrammetry; or 2) verification of agreement with existing DTM and new LIDAR data.

Surdex uses the Intergraph ImageStation Automatic Triangulation (ISAT) software. ISAT has proven to be extremely robust and accurate in automatically collecting both pass and tie points within a block. Only minimal editing is required by the AT technicians. The ISAT software is complemented by a host of applications developed by Surdex using Intergraph's "Photo Foundation" applications programmer interface (API). The results of each block are retained in the "PhotoDB" of the Enterprise database. The aerotriangulation of a block involves several steps:

- Automatic pass and tie point collection
- Editing points
- Measurement of ground control points
- Solving the block
- Publishing the block.

Orthorectification

Orthorectification will be performed using a proprietary suite of software developed by Surdex over the last six years. In addition to cubic convolution processing algorithms, this software communicates results, status, and performance to various internal databases used to monitor production activities. The software is geared toward extremely high performance and utilizes the EnFuzion distributed processing environment.

Only the neat area (central portion) of each image will be used. The extent of each digital orthophoto is defined during the AT publish step, which creates the batch scripts required for all processing. The neat bounds of each image is determined using a target overlap of a few hundred pixels on each side of each image.

The use of neat bounds has two advantages, all stemming from using a reduced portion of the orthoimage during production:

- Accuracy is maintained
- Image quality is preserved.

By limiting the extent of the processing, the geometry of each image is confined to approximately the "center" of each image. This reduces distortions and errors normally occurring at the extremes of each image and ensures that accuracy specifications are met. Any errors in the elevation model are minimized by keeping the "obliquity" at each point to a minimum.

The smaller area of each digital orthophoto preserves image quality by reducing any residual affects of haze and/or sun angle illumination. The few hundred pixels of overlap provide sufficient latitude during balancing and cut-lining operations in the Mosaicking step.

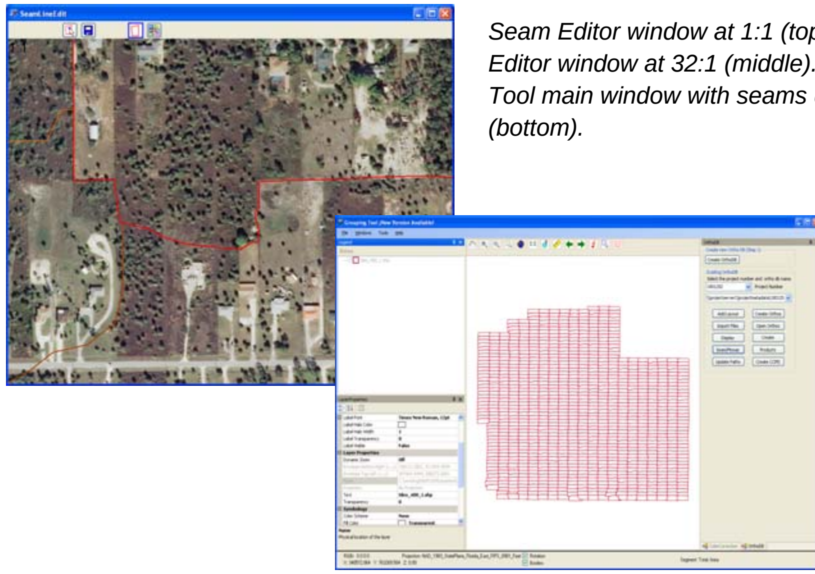
Mosaicking

Mosaicking is used to create a seamless set of Master Tiles. Its inputs are simply the neat orthos along with shape files that guide editing of specular reflection and obscured/smeared areas. Once these corrections are made, seamlines are generated to stitch the orthos together and a minor overall balancing is performed to ensure consistent tone and balance across all joins of the orthos.

Seamline Generation

There are three programs that make up the Surdex seam tools:

- **sdxSeamLine** automatically creates the seams
- The **Seam Editor** is an interactive tool managed and called from within Grouping Tool
- **sdxSeamMosaic** applies the seamlines to create the Master Tiles.



Seam Editor window at 1:1 (top); Seam Editor window at 32:1 (middle). Grouping Tool main window with seams displayed (bottom).

Both the automatic seam generation and tile writing are queued from within Grouping Tool for execution on the Surdex distributed processing servers. The distributed processing provides 44 parallel executions of the seam line generator or seam mosaic applications providing very rapid product generation. Seamline data is stored in a database as OGC simple binary objects.

The basic task of determining the best seam placement can become quite complex. We have created a cost-based approach that analyzes the cost of many paths to create the best seam around each image. Multiple cost factors can be weighted by the technician to provide flexibility to tailor seam placement strategy to the landform and land cover for a given project. The technician selects the weights for each of the cost factors. If one factor is weighted at 100 percent it will be used exclusively. A mix of percentage weights will result in the software calculating a cost for each path by summing the weighted contribution of each cost factor.

Once the automatic seams are generated the technician must review the results and set seams to an accepted state prior to writing out Master Tiles. Notes made during the 100 percent inspection of the raw frames stored in the database are used to display thematic color coded symbols in Grouping Tool to indicate seams that may need manual edits to avoid inclusion of clouds or specular reflection. Topology validation and small polygon validation is run to confirm final polygons meet specifications. The operator will log the acceptance to the database. Each seam polygon carries a record of who accepted it and when. Once an area of seams has been accepted the user selects tiles to be generated and adds them to the distributed processing queue.

After creation of the master tiles, Surdex technicians will perform an additional QC check of the mosaicked ortho data.During QC, any required corrections will be made to the Master Tiles and the affected products in the various reference frames will be re-created, ensuring that data in the overlaps are completely identical. QC checks will include, but not be limited to the following:

- Editing of specular reflections and occlusion or smearing caused by rugged terrain
- Seamline generation
- Final balancing.

Smear Correction

The orthorectification module uses an anchor point approach to assigning pixels to each position in the image. A rigorous ray trace implementation is exceedingly slow and not needed unless the terrain is very rugged. This means that smearing and possibly occlusion could occur in mountainous areas and areas may have to be "patched in" from surrounding orthos. To avoid this possibility, Surdex has developed a ray trace function that analyzes each ortho and determines whether smearing or occlusion is present. The output of this function includes polygons delineating potential problem areas in ESRI shape file format. These shape files will guide technicians to determine which orthos need correction, thus ensuring no smear or occlusion is evident in the final product.

Specular Reflection Correction

Specular reflections caused by glare from sun reflections off water bodies and/or large structures will be present in some the imagery. Surdex will minimize this effect by patching in alternate views of the affected area from overlapping adjacent frames (either from within a line or an adjacent line). During the 100 percent image inspection, technicians note images containing specular reflections that may violate specifications. Ortho technicians are supplied a shape file from the FlightDB that highlights exposures containing specular reflection, thus relieving the technicians from having to search for, and locate, areas that may need editing.

Final Balancing

If required, OrthoVista is used to perform minor balancing in the overlaps of the digital orthophotos. Though the image processing which precedes all production steps handles 90 percent or more of the final image characteristics, some localized balancing may often required around the seamlines. This is a minor alteration that does not affect image colorimetry in a global sense. OrthoVista uses an iterative process to perform the color balancing. Each iteration drives a group of orthos to the final color and adjusts overlaps with surrounding groups. Thus, this is not a matter of simply adjusting the color for a group, but blending it into its surrounding. The more consistent the overall input color balance is, the fewer the iterations that will be required. Surdex normally uses only a few iterations, resulting in nearly imperceptible changes.

Digital Terrain Model/Contours Update

At the discretion of the City, Surdex is fully capable to update the existing two foot contour DTM data adhering to the specified accuracy requirement via photogrammetric methods. Surdex has determined that the acquisition altitude of 3,300' above mean terrain (amt) is completely suitable for production of DTM data capable of producing 2-foot contours at the prescribed accuracy. This altitude was derived based on the requirements of the City's ortho resolution requirements and industry accepted altitudes for 2-foot contours.

Understanding the utility of the optional LiDAR, Surdex recommends the LiDAR be used in concert with the digital imagery to produce the contour update. Surdex will overlay the bare earth LiDAR data over the newly acquired stereo imagery for review. Using planimetric data and shapefiles provided by the City as a guide, Surdex will identify areas of visible change. Large areas of wholesale change will be readily identifiable for updates. Less significant areas requiring update will require stereo compilation technicians to "probe" the existing surface in 3-D and compare the results to the elevations measured in the LiDAR data.

As an area is identified that requires updating, technicians will create a polygon encompassing the update area and minimal terrain determined valid to ensure a consistent tie to the existing surface. The existing data will be cut from the DTM file and new data representing the current surface will be added. The technicians will compile required breaklines, extending the existing breakline data into the update area(s) using industry accepted standard stereocompilation methods. Breaklines will be placed at all major changes in the surface (i.e., drainage, roads, terrain breaks, etc.). Mass spot points will be added following the existing point density utilized in the previous data.

Upon completion of the DTM collection, contours will be generated at 2-foot intervals. Spot points will be placed at tops of hills, saddles, road intersections, bridges, etc. and in areas of flat terrain not represented by the contours. The contours will be reviewed for accuracy and consistency by viewing the contour data in 3-D overlaid on the stereo imagery. Contours will be scrutinized to ensure that updated contours seamlessly tie to the existing contours and present a true representation of the topographic characteristics. If inconsistencies or inaccuracies are found, the compilation technicians will revisit the DTM data and correct as necessary, regenerate, and validate the final contour data as correct. The contours will not be significantly edited or modified unilaterally which would create disparate data sets between the DTM and final published contour data.

After the contour data are deemed complete, the data will be passed through a final edit to ensure that the data are topologically correct and suitable for use in the GIS.

LiDAR Option

For LiDAR acquisition, Surdex will use our Leica ALS 50-II Aerial LiDAR Scanner equipped with Multiple-Pulse-in-the-Air (MPiA) technology. Surdex's current system is a multiple-return LiDAR system capturing multiple ranges for each pulse along with intensity images.

Surdex utilizes automated and manual procedures to process LiDAR data and GPS/IMU data to generate DEMs. Auto-filtering removes much of the artifacts, but manual editing is used to create a bare-earth model where structures, buildings, plants, trees, and brush have been removed.

Project Design

When designing the project, Surdex includes:

1. Final definition of the project bounds with appropriate buffering to arrive at a net LiDAR coverage.

2. Ground survey control and base station design, possibly causing changes in LiDAR coverage due to ground survey access restrictions.

3. Flight planning of LiDAR acquisition.

The LiDAR flight planning is primarily based upon swath overlap, pulse density, and field of view (FOV). Derived parameters include the flying height above mean terrain. Detailed planning involves using elevation models to ensure variations in terrain do not result in gaps in coverage or loss of desirable swath overlap. Following is a brief description of the LiDAR setting for the City of Branson project.

Flying height	1,600 meters
Field of view	40°
Max laser pulse rate	137,300
MultiPulse in air mode	Enabled
Swath width	1164.70 meters
Max line spacing	881.06 meters
Minimum sidelap	25 percent
Average point density	1.53 pts/m^2
Average point spacing	.81 meters
Illuminated footprint diameter	.37 m

- Estimated across track accuracy 0.17-0.20 m
- Estimated along track accuracy 0.17-0.19 m
- Estimated height accuracy 0.07-0.10 m

Acquisition

Surdex's chief pilot acts as flight coordinator for the project and works directly with the Surdex project manager. At the end of each flight day, all acquisition reports will be conveyed to Surdex for update of acquisition status and merged with on-going inspection. Results from each day's acquisition can be loaded to a project website for review by the client. The project manager will proactively point out deviations from planned performance to the client via approved communication channel(s).

Inspection

Surdex's flight management database is loaded with inspection results to ensure operations and project managers are fully aware of status for the entire project.

All ABGPS/IMU data will be transmitted at the end of each flight day to ensure the information is acceptable for use. A certified photogrammetrist performs the final review to determine acceptability. It is a goal of the project to finalize this review within 24 hours of receipt.

As LiDAR data arrives from the field, it is immediately processed to a ground projection and inspected for data integrity and accuracy against calibration sites flown before and after each mission. It is another goal of the project to achieve this final inspection within 48 hours of receipt of the data.

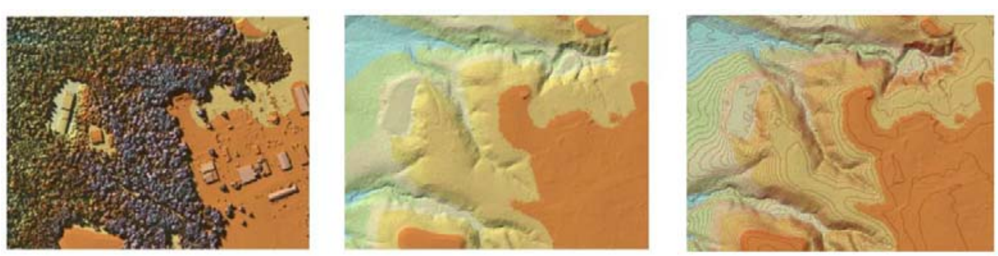
Processing of LiDAR Data

Proprietary boresighting and calibration software calculate the system boresight angles and LiDAR/IMU lever arms from passes collected over the calibration site at the beginning of each project. Once calibrated, the parameters can be verified at the start and end of each mission for quality control.

GPS and IMU processing are performed with the Waypoint GrafNav and Applanix PosProc software. The LiDAR data will be processed to project coordinates using proprietary software. Sidelaps between flight lines will be examined for systematic or time-dependent discrepancies and cross-flight analysis will be performed to ensure proper calibration and system operation.

Classification / Bare-Earth Reduction Process

The resulting point cloud representing the reflective surface—or digital surface model (DSM)—for most mapping projects will be heterogeneous in nature (i.e., a complex mixture of hard ground, low vegetation, underbrush, canopy and man-made features such as buildings, power lines, etc.). To arrive at a bare-earth DTM, the ground returns must be separated from the rest of the LiDAR returns, a process called classification



Classification. *This process is used to separate ground returns from the rest of the LiDAR returns. The image on the left is all returns. Trees, buildings and ground are visible. The center image is classified to show only bare earth. We have removed the things above the ground, i.e. trees and buildings. The image on the right is contours formed from the bare-earth points.*

After detection and removal of spurious low points, ground classification of the full data set is performed. Using a combination of TerraSolid's TerraScan and proprietary software, the bare-earth data set is extracted and usually thinned to create the optimal ground elevation DTM model. With selectable control of the classification parameters by area, bare-earth processing can be tailored to differing terrain and vegetation types. Parameters can be varied based on surface morphology, such as slope and curvature and cultural features, such as building size.

The resulting surface from the automatic classification is then reviewed and manually edited to re-classify any false ground or vegetation classifications. Suspect areas are identified and manually edited to remove remaining building and vegetation features. The coincident RGB color channel collected with our system is used to QC the ground results and to assist in manual editing.

LiDAR Classification of Trees and Bare Earth

For orthophoto DTMs, bridge and overpass elevations that may have been removed from the surface in automated processing can be added back into the DTM. For topographic mapping, remaining bridge segments must be removed for hydro-enforcement. Elevations within water boundaries can also be removed or modified in a 2D editing environment.

LiDAR collects data points in a roughly gridded pattern. This sampling of the terrain features results in over-collection of elevation points in flat areas and under-collection in areas of sharp breaks, such as ditches and small streams. Depending upon the accuracy requirements of the DTM, breaklines can be added in 2D to improve the location of the feature edges.

LiDAR Project Design

The Surdex project design allows for the generation of LiDAR ground points that are accurate enough to support the generation of two foot contours over the project update areas. The generation of LiDAR elevation data can be divided into two types of information.

Level I – This data represents a bare-earth surface that is automatically generated and manually edited from the classification process. This data is relatively accurate, but may contain some data anomalies. This data may be used for the DEM for orthorectification and the quick representation of 2-foot contours.

Level II – This data consists of Level I data that has been further processed to add additional breaklines and spot elevations that will support the accurate generation of contours, most commonly 2-foot. Areas of incorrect bare-earth classification are also removed in the processing. The edits are performed on photogrammetric workstations. This process, to be used for the Branson project, generates engineering grade contours or FEMA DFIRM-compliant contours (2 foot).

Photogrammetric Edits

aS stated previously, the photogrammetric edits of the LiDAR elevation data will be performed on photogrammetric workstations in stereo. The digital imagery will be imported in stereo and presented to the technicians. The ground classified LiDAR data will be imported and displayed in stereo on the imagery. Where necessary the contours will be enhanced with new breaklines, mass points and spot elevations. The final output of this process will be refined contour data that matches the ground.

Oblique Orthophotography Option

Pictometry International Corp. has been the leading provider of geo-referenced aerial image libraries and related software for more than 10 years. With over 925 U.S. counties as customers, Pictometry has amassed imagery in all 50 states, all of the top 133 U.S. cities and over 90 percent of the urbanized area census tracts. Pictometry captures this imagery with a fleet of 53 single- and multi-engine aircraft, outfitted with Pictometry's patented oblique capture technology and processes 100 percent of this data at its Rochester-based facilities without the use of any subcontractors. Pictometry's oblique camera system is the only oblique capture system that has been approved by the USGS. Our camera technology has been certified by the USGS as capable of providing quality, consistent image data to support civil government programs at the performance level specified in the USGS Sensor Type Certification Report.

Pictometry's unique PentaView capture system will capture forward, rear-ward, and side-ward looking digital oblique images of the 57 square miles of area for the City of Branson, MO, producing metric, oblique images that we georeference without requiring the traditional authoritative ortho-photos to do so. Our Electronic Field Study (EFS) viewing and measuring software will accompany Branson's image library. The City will be provided with an enterprise wide license to EFS for deployment to any city/county agency in the City of Branson and Taney County, and to any municipality or public school within the City of Branson and Taney County. It will allow Branson's users to measure bearing, angles, pitch and elevation, and pan, zoom, rotate and navigate on their images. Our oblique images can also be viewed through ESRI's Arc GIS Extension with many of the same measuring and navigation capabilities. In addition, Branson's GIS layers can be overlaid directly onto the imagery for further data extraction.

With the City of Branson's full image library purchase, Pictometry provides its Economic Alliance Partnership program in which it promises to image, at no additional charge, up to 200 square miles of affected areas of Federally Declared Disasters caused by Hurricanes (Category 2 and above), populated areas affected by fires, terrorist attacks, Tsunami and Earthquakes. This imagery would include the use of our ready-to-use Change Analysis software for ninety days.

Pictometry Oblique Imagery Offering

Pictometry's color oblique images are directly geo-referenced images with onboard GPS and IMU data which provide accurate position and altitude of the camera at exposure time. This highly accurate digital camera calibration procedure not only calculates the internal geometry of the system but also detects any pixel aberrations (this calibration process was licensed to USGS in 2003 and has been adopted as the standard calibration procedure used for all professional digital airborne cameras). Each image is date and time stamped with the time of capture as reported by the time information transmitted from the GPS. Ground-based differential corrections are applied and Kalman Filtering is done to further improve the accuracy of the data. Pictometry regularly calibrates each 16-megapixel camera and lens pairing and automatically selects the latest calibration data based on digital camera ID and capture date.

For the City of Branson, Pictometry will capture four-way 4-inch ground sample distance (GSD) resolution geo-referenced oblique images, as well as two-way 12-inch GSD images. All oblique images will be geo-referenced to the Missouri Central State Plane Coordinate System, NAD 83, US Survey Feet. The oblique image library will be delivered to the City of Branson within 60 days of last image capture. Intuitive, on-site (or through GoToMeeting) training will be completed soon afterward.

Pictometry understands that the City also seeks a web-based software application for deployment on City servers. Our Self Hosting Pictometry Online solution utilizes Pictometry Web Solutions technology and will allow the City to house its complete image library on its own servers for distribution to its agencies, with full control over its image data.

Sample High-level Oblique Image

Sample Low-level Oblique Image

Pictometry may capture images when there are clouds above the altitude of the aircraft. In fact, the best lighting for the Pictometry images is when there is a light, high cloud cover, as this provides the most consistent lighting coverage. The preferred capture windows are when the leaf canopies are off and the ground is not obscured by snow or ice. Because of this, Pictometry can continue to capture imagery even if the sun angle dips below 30º. We constantly monitor weather, foliage and snow conditions, and plan our deployment of resources to maximize the capture windows of opportunity.

- **Color, Color Scheme:** Pictometry's system produces 24-bit RGB color.
- **Tint, Contrast:** Pictometry's capture system has a high dynamic range image sensor and full control over the lens iris and camera exposure times in order to maximize exposures.
- **File Formats:** Pictometry's Oblique images (and individual orthorectified frames) are delivered in JPEG format with a custom trailer containing all of the metadata necessary to geo-reference the imagery for use in Pictometry's Proprietary Software Suite. Orthogonal imagery is available tiled in GeoTIFF and/or JPG format, as well as mosaicked in ECW and/or MrSID formats. Other formats may be available upon request.
- **Date/Time Stamp:** Each image is date and time stamped with the time of capture as reported by the time information transmitted from the Global Positioning System.
- **File Size:** Each raw image is 48 MB in uncompressed 24-bit RGB form. Pictometry will allow the City of Branson to select the file format and compression rate. Pictometry typically uses a JPEG compression rate that yields 8 MB images, as this provides a high compression ratio with minimal effects on image quality. Actual compression ratios and elevation data integration rates will be negotiated with the City to ensure a manageable delivery size.
- **Accuracy:** Pictometry's oblique and individual frame ortho images are directly geo-referenced images with onboard GPS and IMU data which measure the plane's orientation 300 times per second. They provide the accurate position and altitude of the camera at exposure time. Ground-based differential corrections are applied and Kalman Filtering is done to further improve the accuracy of the data.
- **Image Footprint:** Pictometry images are captured with a landscape orientation in order to maximize the highly detailed portion of the image.
- **Project Support:** Most of Pictometry's project support is based in Rochester, NY, Pictometry's principle location. Chad Rhinewald, our most seasoned Project Manager, will oversee the image capture process, coordinate scheduling logistics with the City of Branson's staff, manage Pictometry's flight planners, and supervise the project end-to-end. He will work closely with Pat Blankfard, our VP of Production to ensure the flight capture is done to the 4- and 12-inch GSD, in the timeframe requested by the City. He'll also work closely with Tim Harrington, our VP of Processing to ensure the imagery is processed to the City's specifications, and that any of the City's GIS overlays are included. A Customer Technical Services

Representative (CTSR) will also be available for onsite training on Pictometry's products and software solutions, or remotely through *GoToMeeting*. Additionally, both Christian Stitz, the Regional Technical Manager in Missouri, and Howard McGee, the District Manager in Missouri, will always be available to the City of Branson for technical and account support.

Pictometry looks forward to providing its superior oblique imagery to the City of Branson for this project. Because 33 counties and municipalities in Missouri already have Pictometry's imagery and software, the City of Branson and Taney County will be able to share its oblique imagery with its neighboring counties for planning purposes and emergency response situations. We are confident the City of Branson will realize a return on investment by saving time, reduced field visits through new desktop capabilities, and additional tax revenues that will easily surpass the cost of its Pictometry image capture.

Proposal

DIGITAL ORTHOPHOTOGRAPHY, OBLIQUE IMAGERY AND DIGITAL TOPOGRAPHIC MAPPING

CITY OF BRANSON, BRANSON, MISSOURI

January 28, 2011

WOOLPERT

DESIGN | GEOSPATIAL | INFRASTRUCTURE

WOOLPERT

DESIGN | GEOSPATIAL | INFRASTRUCTURE

January 27, 2011

Mr. Curtis J. Copeland, GIS Coordinator
City of Branson
110 W. Maddux Street, Suite 310
Branson, Missouri 65616

Dear Mr. Copeland:

Woolpert is pleased to submit this proposal to the city of Branson in response to your request for digital orthophotography, oblique imagery and digital topographic mapping. It is our sincere desire to demonstrate through this proposal that we possess a keen understanding of the City's needs, the solutions to address those needs, and the highest qualifications to provide for those needs. As one of the nation's most respected surveying and mapping firms, Woolpert has been an innovator in the survey and mapping field for almost 100 years. We proudly extend that tradition of innovation and service to your staff.

Woolpert is very aware that the true success of every project is directly related to the qualifications of the professional staff executing the work. We are confident that you will find Woolpert to be exceptionally qualified and experienced in all professional disciplines required for this project. Our team has the equipment and—more importantly—the expertise to perform the work in a manner that will meet and exceed your expectations.

With an office in the state of Missouri since 1988, we take great pride in working closely with our clients to provide services that meet the needs of their demanding projects. We hope that—even in this proposal—our team's experience, insight, and dedication to you is evident. We appreciate this chance to present our qualification to the City of Branson and we look forward to the opportunity to continue our service to you. Please contact me directly at 937.531.1323 or at brian.stevens@woolpert.com if you have any questions. Thank you.

Sincerely,

Woolpert, Inc.

Brian Stevens, CP
Project Manager

Robert F. Brinkman, CP
Senior Vice President and Authorized Signatory

woolpert

DIGITAL ORTHOPHOTOGRAPHY, OBLIQUE IMAGERY AND DIGITAL TOPOGRAPHIC MAPPING PROJECT

OVERVIEW

Woolpert is a multidiscipline professional services consulting firm that provides expertise and solutions in partnership with a broad range of public and private sector clients. Woolpert offers a full palette of planning, design, engineering, and geospatial services that solve clients' problems through results-focused consulting, creative yet practical design, and the appropriate use of technology.

Woolpert's history spans 100 years of client satisfaction. Founded in Dayton, Ohio in 1911, Woolpert has been in business continuously since that time. Initially providing surveying services exclusively, the firm has evolved to meet the ever changing needs of the military, government agencies, institutions, and private development clients. Woolpert today is a full service firm that adapts to meet new challenges.

Engineering News Record (ENR) consistently ranks Woolpert among the top 100 design firms in the nation. Approximately 80% of Woolpert's clients are return customers. Our success in managing deadlines, controlling expenses, and producing a quality product gives our clients the confidence to entrust their projects to us, time and again. To find out more about Woolpert, visit us at www.woolpert.com

EXECUTIVE SUMMARY

Woolpert understands that the City of Branson is soliciting for a firm to provide base mapping services, including the acquisition of aerial imagery, LiDAR, color orthoimagery, oblique imagery and the production/delivery of citywide 2-foot contours.

It is also understood that the City of Branson requires that the work performed for this project be completed within the United States and that it is preferred that one vendor perform all services. A US-based firm ourselves, we appreciate the City's desire not to have work performed offshore. Furthermore, by having an office in Fairview Heights, IL office since 1988 and St. Louis, MO since 1995, we are proud to say we support the tax base of the state. With nearly 250 employees within our Geospatial Service Line and numerous offices located throughout the US, Woolpert has the resources needed to perform all work, on time and within budget. Woolpert's philosophy relies upon the use of technology and the efficiencies and advances obtained through the use of technology.

Woolpert appreciates the City's desire to have work performed within the United States. A US-based firm ourselves, we do not support the use of offshore labor.

Woolpert's digital aerial camera (3OC) and software solutions provide an alternative that no other firm can offer. Woolpert's SmartView offers the City of Branson a solution developed around the use of a geometric aerial mapping camera, capable of providing a constant pixel size and scale across the entire project area. SmartView also provides the City a solution that is not licensed and does not come with additional fees for software.

Since Woolpert's solution involves the acquisition of aerial imagery and LiDAR, we also want to make the City aware of additional solutions possible by leveraging existing base mapping products. Over the last few years, Woolpert has taken advantage of technology by providing services produced through remote sensing/automated feature extraction technology and techniques. This provides Woolpert a unique option of providing clients value added services (i.e. impervious surface delineation, land-cover delineation, woodland extraction, etc.) through the use of existing base mapping data (i.e. LiDAR and orthos). This provides the City with additional options and a way to leverage existing investments in geospatial data.

Specific Missouri Experience

Woolpert has completed or is currently working on 20 surveys or mapping projects at airports in Missouri. This experience makes Woolpert very familiar with the locality of the project and the various changes in terrain as well as federal, state and local conditions. The projects completed in Missouri have come through contracts with design/planning consultants, the FAA, and MoDOT, providing an all encompassing level of experience and understanding of intricacies of MoDOT designed projects.

Beyond providing aviation geospatial services, Woolpert has a lengthy history or work in Missouri for federal, state, local municipalities, and private industry clients. Clients such as the US Corps of Engineers completing planimetric, control and utility surveys to support the national levee program, City of St. Charles completing utility inventory, geodetic control surveys and enterprise information management system development to support their storm and sanitary GIS development and multiple development and construction firms to support site planning and design services.

PROJECT MANAGEMENT

Knowing that effective project management is a major component of a successful project, Woolpert stresses the following seven PM components:

- Project Planning
- Establish project budgets
- Set the schedule
- Determine and acquire needed resources
- Monitor budgets and schedules
- Monitor tasks to ensure quality control
- Establish project communications

We have outlined the requirements for all seven steps below to demonstrate the importance we place on project management for this assignment.

Step 1: Project Planning. Brian will begin planning each work assignment after the specifications for that assignment have been agreed upon and finalized in writing. Woolpert team members, with significant input and feedback from City staff, will thoroughly discuss the scope of work to gain a clear understanding of the requirements, goals, and objectives for each assignment. Project planning requires that the work be divided into phases and subdivided into work tasks. Most importantly the inclusion and feedback from relevant personnel will be communicated, both internally for the Woolpert team, and externally with appropriate City staff.

Step 2: Establish Project Budgets. Brian will assign a budget of work hours for each phase. These budgets help Woolpert monitor the financial status of each work assignment. The budgeting process will identify labor categories required for each phase or task; estimate the number of hours; and calculate fees and establish invoicing procedures.

Step 3: Set the Schedule. Using this proposed schedule as a starting point, Woolpert and the City will arrive together at an incremental schedule that meets the needs of all parties.

Step 4: Determine and Acquire Needed Resources. Brian—working with our production managers—will evaluate the staff and equipment available to the project, taking the following factors into account: amount of equipment and number of staff available; available staff hours and equipment hours; hours budgeted for a phase or project; time to complete the work; and existing workload.

Step 5: Monitor Budgets and Schedule. Brian's responsibility for project management doesn't end with project planning, budgeting, and scheduling. In addition, he will monitor budgets and schedules to identify potential problems so that the project stays on track. Our project and group managers take advantage of our MIS system that tracks hours billed to the project and invoices sent and received. We also use Microsoft Project to track milestones, timelines, and budgets. The project Gantt chart is often included on a project website, as detailed later in this document.

Step 6: Monitor Tasks to Ensure Quality Control. Brian takes the lead in setting the standards for quality products and is responsible for ensuring that quality control procedures are carried out continuously. In general, he uses these measures to monitor tasks and ensure quality control on each work assignment:

- **Standards.** Brian will ensure that internal standards are in place for your project.
- **Digital and Visual verification processes.** Brian will confirm that any errors that are found during our digital and visual verification processes are addressed before final delivery of your data.

Step 7: Establish Project Communications. The level of communication and coordination required to successfully execute a project of this scope is extensive. For this reason, Woolpert uses a wide variety of communication techniques, to include: telephone and faxes; Email; FTP site; NetMeeting; onsite visits; meetings; progress reports; and a project website.

Through all these methods, Brian can properly coordinate our team's efforts and give the City timely answers to their questions. All these communication devices add up to an environment that allows our clients to stay well informed about the progress of demanding projects. We take our level of commitment to our client's seriously, which is reflected in everything we do.

PROFESSIONAL EXPERIENCE AND TECHNICAL COMPETENCE—SCOPE OF SERVICES

WOOLPERT SMARTVIEW OBLIQUE AERIAL VIEW (OAV) IMAGERY

For oblique aerial imagery projects, Woolpert uses our SmartView aerial sensor. SmartViewTM is a custom, state-of-the-art digital camera system and image processing workflow that uses three-line scanning principals to produce four cardinal 45 degree oblique views, as well as the traditional vertical orthoimage. Woolpert has developed processing techniques for ortho rectifying and mosaicking the imagery to provide seamless oblique image coverage from the forward-looking, nadir-looking and back-looking directions.

Woolpert's SmartViewTM 3OC Oblique digital push broom camera and processing workflow was designed and developed by Woolpert to provide a superior technology for oblique imagery. Woolpert's Oblique Aerial View (OAV) digital imagery approach provides oblique imagery and traditional nadir orthoimagery by providing multiple, angled views of ground features, allowing decision makers to see an area of interest in context to its surrounding features, regardless of which oblique angle is being viewed.

Traditional OAV collection approaches rely on frame-by-frame image gathering, which results in numerous single-frame images requiring storage and management by third-party, proprietary software. These approaches can fall short on accuracy, and provide limited viewing and roaming capabilities. The SmartView camera technology is linked with an image-processing workflow that uses three-line scanning principals rather than the traditional frame-based approach. The Wehrli 3OC is a 12-bit all digital aerial sensor. This is a large format digital sensor that acquires imagery using three-line scanning principals to produce four cardinal 45 degree angled views, as well as the traditional nadir view. Similar to the Leica ADS systems, the 3OC is equipped with GPS and inertial measurement unit (IMU) systems. The IMU collects aircraft attitude information, and the airborne GPS records the position of the aircraft. The GPS and IMU data are post-processed and integrated into a best estimate of trajectory that is used for geo-referencing each scanner line, and to support the OAV image processing and rectification. The fixed focal length and fixed angle view provide oblique and nadir imagery with a consistent pixel size. The result is a continuous oblique and nadir view digital imagery data set compatible with existing GIS, CADD, and map-server systems.

In addition to the SmartView oblique imagery, Woolpert's SmartView™ Application Suite is also provided. The Application Suite is an unlimited use, royalty-free collection of tools that provides users with the ability to view, catalog, organize, and retrieve our SmartView imagery as well as integrate seamlessly with the ArcGIS Desktop environment. Integration is achieved through our SmartView™ ArcGIS Extension. The Extension provides the ability to manage the display and positioning of the ortho imagery as well as any of the four cardinal view oblique images simultaneously, all with a single click of a button. In addition, Woolpert has developed a set of oblique image measurement tools that are included in each of the applications. These measurement tools more accurately provide vertical measurements of our oblique imagery. Easy-to-use documentation describing the functionality and use of each of the applications is also provided.

SmartView Oblique Camera System. 3OC-1 Digital Oblique Camera System

- Developed from Large Format Aerial Camera Platform
- Utilizes aircraft designed and dedicated to aerial image acquisition

SmartView Benefits

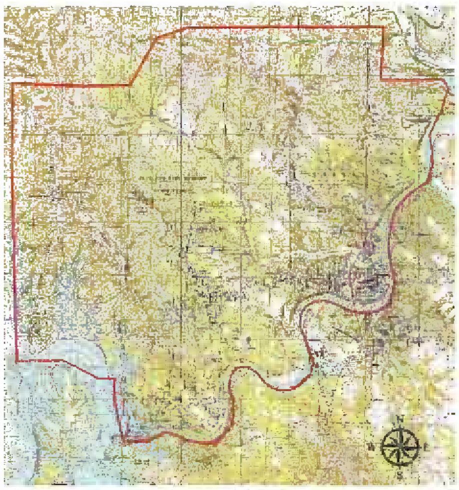
- Technical Approach—Photogrammetric Approved
- Continuous Oblique Concept—One Single Image for each view
- File Size—Reduced File Size for Mobile Use
- Accuracy—Data Layers Overlaid with Confidence
- Integration—ArcGIS, AutoCAD, MicroStation, etc.
- Web-Based Application—MrSID, GeoJPG2000, ECW
- Software and Licenses—No 3rd Party Required
- Orthoimagery—Nadir Orthoimagery with Obliques
- Functionality—Easy to Use
- Ownership—No Licenses or Multi-Year Contracts

SmartView Uses

- Property Assessment and Evaluation
- Highway Sign Inventory and Bridge Assessment
- Imagery for Building Facade extraction - 3D City Modeling

Woolpert SmartView OAV Process

Flight Plan/Aircraft. A final flight plan will be developed in consultation with the City of Branson and provided as a digital file. To produce four cardinal 45-degree angled views and the vertical view, Woolpert's flight plan will consist of both east-west and north-south single pass flight missions and be flown at an altitude to acquire a 4-inch pixel resolution. For both the acquisition of aerial imagery and LiDAR, Woolpert owns and operates three Cessna 404 Twin Engine Aircraft.


Project Boundary

Time and Conditions during Imagery Acquisition. The aerial imagery will be obtained during the most suitable flying conditions—leaf-off (or light leaf coverage), when the ground is free of haze, snow, smoke, dust, or floodwaters and water bodies shall be ice-free.

Ground Control. Woolpert will work closely with the City of Branson to identify existing ground control points, which can possibly be used/targeted prior to the acquisition of aerial imagery. At this time and given our current understanding of existing ground control, Woolpert has identified the need to establish 12-15 new control points. New control points will be consistent with second order horizontal and third order vertical. For new control points, Woolpert chooses to use photo identifiable points (PID) as often as possible. PID points are more environmentally friendly and avoid unnecessary public intrusion and interference in the community. PID points will be picked on clear, well defined locations that are photo identifiable from the appropriate scale. The PID points will be semi-permanent such as an "X" etched in concrete, PK Nail, or 18" rebar with cap. If suitable PID points cannot be identified, aerial targets will be established.

Airborne GPS. In addition to the ground control points, Woolpert's flight crew will establish a temporary ABGPS ground station at the airport from which they mobilize. This provides the necessary support to achieve accurate airborne GPS during processing of the aerial imagery and reduce the number of needed ground control points.

Datums/Coordinate System. The horizontal datum to be used for the survey and delivery of this project will be NAD83, with the coordinate system being the Missouri State Plane System, Central Zone, units in US Survey Feet. The vertical datum to be used will be NAVD88, units in US Survey Feet.

Aerial Triangulation. Woolpert will utilize softcopy aerial triangulation techniques for the extension and densification of ground control. The aerial triangulation is applicable to all image views.

DEM. Since Woolpert is proposing to acquire LiDAR as part of the project, the LiDAR will serve as both a means to rectify aerial imagery and provide the basis for new 2-foot contours.

Image Rectification and Mosaicking NADIR View (Vertical View). Woolpert will use a systematic approach to produce the nadir (vertical) digital orthoimagery. The resulting digital orthoimages will have a 4-inch primary pixel resolution with accurate X, Y ground coordinates, and RGB scale values from 0 to 255. Woolpert will deliver ortho-rectified nadir imagery in an approved tile format. The imagery will be delivered in GeoTIFF format. Additionally, Woolpert will deliver a nadir citywide MrSID mosaic using a 20:1 or city approved compression ratio. **For the 12-inch requirement, Woolpert will resample the base 4-inch imagery dataset.**

Accuracy. The 4-inch orthoimagery will meet the NMAS accuracy for 1"=100' scale mapping.

Image Rectification Oblique Views. A planar rectification is carried out on each of the four (4) oblique views. The result is the oblique view imagery will be geo-referenced, however it will NOT be ortho-rectified. Oblique imagery will be delivered in TIFF image format (ER Mapper's ECW Image Format is recommended). MrSID compressed images will also be delivered. **For the 12-inch requirement, Woolpert will resample the base 4-inch imagery dataset, thus reducing processing effort and time.**

SmartViewTM Application Suite. The application suite provides image viewing capabilities of the nadir, or traditional top-down, orthoimagery as well as 45-dregree oblique imagery for each of the four cardinal views. Woolpert will provide one (1) copy of the Application Suite containing our SmartView™ Desktop, SmartView™ ArcGIS Extension and SmartView™ Connect applications. Available functionality for each application is listed below. Woolpert will provide each application as-is.

SmartView™ Desktop. SmartView Desktop is based on the NASA World Wind SDK. World Wind is an open-source, fully interactive 3D globe that allows users to zoom from satellite altitude to any place on the Earth. By leveraging SmartView imagery, users can experience oblique imagery in a visually rich environment, just as if they were really there.

The following are the functional capabilities within SmartView Desktop application.

Desktop and Portable Editions

- SmartView™ nadir and oblique imagery management
- Add/remove supporting data layers
- Query/Review attribute information
- **Zoom in/out**
- **Pan**
- **Tilt**
- **Pitch**
- **Print map**
- Navigate display
- GPS integration through NMEA stream
- Measure distances
- Measure paths
- Measure heights
- Measure vertical areas
- Measure horizontal areas
- Synchronize with the SmartView™ ArcGIS Extension - Desktop Edition only
- **Capture screenshots**

SmartView™ ArcGIS Extension. The SmartView ArcGIS Extension is a custom ArcMap toolbar containing tools necessary for users to display, analyze, and manage SmartView imagery within the ArcGIS environment. The toolbar is available to users within any ArcMap document (.MXD).

The following are the additional functional capabilities within the SmartView ArcGIS Extension application.

ArcMap Window

- SmartView™ nadir and oblique imagery management
- Standard out-of-the-box ArcMap functionality
- Synchronize with the SmartView™ Desktop Edition
- Create oblique image view windows
- Synchronize oblique image views
- Print Map

Oblique Image View Windows

- Zoom in/out
- Pan
- Print map
- Copy view to clipboard
- Navigate display
- Measure distances
- Measure paths
- Measure heights
- Measure vertical areas
- Measure horizontal areas
- Synchronize oblique image views
- Set independent view scales

SmartViewTM Application Suite Implementation. Woolpert will provide installation packages for each of the two applications within the SmartViewTM Application Suite, user-guides, instructions for downloading and installing each application along with the nadir and oblique imagery on an external hard drive. If necessary, Woolpert will also provide up to two (2) hours of implementation services and technical support via telephone or internet conferencing.

Required hardware and supporting software acquisition and installation will be the responsibility of the City. If desired, Woolpert can assist the City in these endeavors. All requirements are listed in the user guides that will be provided to the City prior to the delivery of the imagery.

LIDAR, DIGITAL TERRAIN MODEL AND 2-FOOT CONTOURS

LiDAR Acquisition/Processing

Woolpert is proposing the acquisition of LiDAR (1.5-meter point density average) for the 57 square mile project area.

The Woolpert team offers the latest in airborne laser mapping technology. Woolpert's airborne LiDAR capacity includes two **Leica ALS50-II MPiA** (Multi Pulses in Air), and two **Optech GEMINI LiDAR** Sensor systems, one with Waveform Digitizer. These systems can be mounted and operated on fixed wing and helicopter platforms. For the 1.5-meter point density requirement of the Branson Project, Woolpert would utilize a fixed wing aircraft. The Woolpert team has the capability to deploy the appropriate LiDAR system to meet project specifications and requirements. Both systems collect high density data point clouds of multiple returns.

Woolpert utilizes a combination of proprietary, "in-house" and commercial off-the-self software packages for processing our topographic LiDAR datasets. Applanix's POSProc along with GrafNav is used for processing the LiDAR system's integrated GPS and IMU data. We use TerraScan to classify LiDAR points, creating a bare-earth model and then subsequently classify the non-ground points to separate out buildings and vegetation. We then use TerraModeler to create surface models. The LiDAR data will be provided in LAS format.

Digital Terrain Model (DTM) and 2-Foot Contours. Using LiDAR as the foundation for the creation of a citywide DTM and 2-foot contours, Woolpert is proposing the use of a compilation technique referred to as LiDARgrammetry.

Woolpert's combined process for creating a DTM maximizes the benefits of software capabilities for quality control and streamlines the entire process.

- **LiDAR.** Use the LiDAR bare-earth data to produce 3D stereoscopic models.
- **Breaklines.** Compilation of 3D breaklines at abrupt changes in slope. Some examples of features that will be represented by breaklines include; natural slope breaks such as

ditches, tops and bottoms of embankments, etc; and constructed slope breaks such as roads and graded areas.

LiDARgrammetry. Woolpert will employ an innovative and integrated mapping approach for DTM and contour collection known as LiDARgrammetry. DATEM softcopy workstations will be used in this process. DATEM systems operate MicroStation software for photogrammetric compilation. Woolpert will use the LiDAR mass points (created from the bare-earth points) and new 2011 orthoimagery, and our LiDARgrammetry software to create the DTM, contours and hydro features. Woolpert has implemented LiDARgrammetry to produce contours on numerous countywide projects. Examples include: Madison County, Indiana; Delaware County, Indiana; Washtenaw County, Michigan; Anderson County, South Carolina and Aiken County, South Carolina.

Woolpert will use the new orthoimagery as part of our methodology. LiDARgrammetry methods used by some vendors, including the colorizing of the LiDAR surface to check for spikes or anomalies, only provides one method of quality control. In addition, breaklines are blindly placed in 2D, not really knowing if they are following a true feature, such as a stream, or a false feature created by the LiDAR surface. **Increased accuracy** is the greatest advantage of our LiDARgrammetry process.

Woolpert will generate 3D models using the LiDAR point cloud and new 2011 orthoimagery draped over the LiDAR surface. The addition of the orthoimagery to the LiDAR surface will enhance the ability to correctly capture mapping features. It will improve the accuracy of the final product by allowing the photogrammetric technician to have two combined methods of QA/QC.

The first method is to view the photographed surface in 3D using the orthoimagery. With the imagery in the background, it is easier to identify and compile DTM/contour/planimetric data based on a visual photo, especially around manmade and hydro features. The second method is to use the LiDAR intensity imagery. With the two procedures, Woolpert's LiDARgrammetry methodology provides additional QA/QC.

With the LiDARgrammetry models created, Woolpert will take advantage of softcopy technology that allows experienced photogrammetric technician to capture data superimposed onto the 3D model. This helps to ensure that the data is collected accurately. We use softcopy workstations to directly capture digital stereo data from the aerial photography. These softcopy workstations use the DATEM and Microstation for photogrammetric compilation. Photogrammetric compilation macros are defined specifically for each project before compilation begins. By entering the feature code of the data to be digitized, all line, symbol, or text attributes are automatically set.

Cartography and Delivery. Upon completion of the DTM and generation of the 2-foot contours, Woolpert's Cartographic Staff will perform a final review, transform the finished product to the appropriate format (ESRI based, geodatabase or shapefile) and prepare the dataset for delivery.

The final 2-foot contour deliverables will include LiDAR masspoints, 3D compiled breaklines (placed where needed) and 2-foot contours, all provided in an ESRI format.

QUALITY CONTROL PROCEDURES

Using our current ISO (International Standards Organization) procedure manual as a guide, Woolpert will provide the City with a Procedures Guide that will identify the production processes and Quality Assurance and Quality Control (QA/QC) procedures that will be used to meet the required accuracy and performance standards of the defined Deliverables. The Procedures Guide will be organized as follows:

- Flight Mission
- Ground Control
- Photogrammetric Processing
- DEM Creation
- Ortho Rectification, Mosaicking and Tiling

Quality Assurance and Quality Control (QA/QC) Strategy. Woolpert's Quality Assurance/Quality Control (QA/QC) procedures are built around our ISO 9001:2000 (International Standards Organization) program. We have been ISO 9001:2000 certified since April 2000 by the National Registry in Washington, DC.

- Our certification is for the acquisition, processing, and utilization of geospatial data through Photogrammetric/Remote Sensing techniques.
- We have thoroughly defined and documented all of our processes and management's approach to QA/QC.
- Through this QA/QC approach, we have established lines of authority and communication, levels of management oversight, coordination between work groups and subcontractors, and synergistic QA/QC checks throughout all of our procedures, and between work groups, project document control mechanisms, project tracking mechanisms, and experience and training needs for personnel.

Woolpert uses a detailed QA/QC process both internally within our Production Team to produce data products as required for this project and an external review process by City staff for final data acceptance. The QA/QC process also provides key quality control methods used during this project with a rigorous methodology and work flow required to provide high quality data deliverables. Our Team also will adhere to the principal of third party review of the initial data capture, in that the staff working on the field data capture work will not review their own work; all data captured will be reviewed by other members of the Team.

The QA/QC process will also be staged with a clear distinction between each production step. In this fashion only high quality data will only make it into the final deliverables.

BUREAU VERITAS
Certification

Certification

WOOLPERT, INC.
PHOTOGRAMMETRY AND REMOTE SENSING
SERVICE LINE

ISO 9001:2000

THE ACQUISITION, PROCESSING AND UTILIZATION OF GEOSPATIAL DATA THROUGH PHOTOGRAMMETRIC/REMOTE SENSING TECHNIQUES TO PROVIDE QUALITY GEOGRAPHIC INFORMATION SOLUTIONS

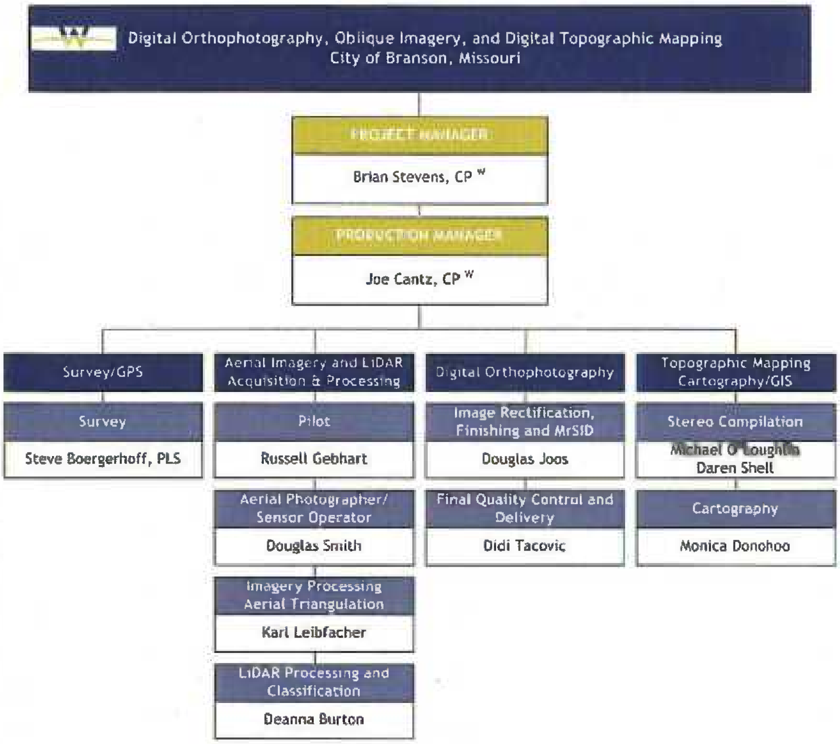
ANAB

Quality Control. During the entire City project, Woolpert will have in place extensive QA/QC procedures as established in our ISO 9001 standards. ISO or International Standards Organization, an organization that helps a company identify and develop a quality management system (QMS). After the process is identified, developed, documented, and has demonstrated compliance to the ISO 9001 quality control model, then that organization may be accredited by the ISO and added to the ISO National Registry.

Many firms profess that they follow ISO quality control procedures. However, there is a difference in merely stating that a firm follows ISO standards and actually achieving certification. Woolpert believes that quality control may by the single most important issue facing our clients today. It is a top priority for Woolpert, too, as demonstrated by our ISO 9001:2000 certification.

KEY STAFF

Woolpert's greatest strength is in our project management and production personnel—highly trained professionals who work efficiently as a team on all aspects of a project. Our team was assembled to provide the city of Branson with a comprehensive array of geospatial experience and capacity to secure success for this and future projects.



Woolpert brings a full spectrum of personnel and technical resources—including experienced staff, available facilities and support infrastructure, and complete corporate commitment—to ensure a rapid initiation of project tasks, and prompt accommodation of potential surge and contingency requirements.

While the professional and technical staff listed in our team organization chart are expected to be the most involved in this project, Woolpert brings a host of additional available resources ensuring our ability to meet project due dates.

BRIAN STEVENS, CP, PROJECT MANAGER

Mr. Stevens is an experienced project manager and certified photogrammetrist who regularly facilitates state and county-wide projects as well as projects for large industrial clients. He identifies resource needs, develops data acquisition QA/QC standards and provides technical assistance while ensuring quality client services.

Mr. Stevens is especially adept at complex projects such as the Ohio Statewide Imagery Project and its byproducts. Despite the size of the project, he ensures that client specifications, scheduling and budgets are met. He is skilled in ESRI products, AutoCAD and MicroStation; he also has supervisory experience.

Contact Information: 4454 Idea Center Boulevard, Dayton, OH 45430.1500; 937.531.1323; 937.938.0307 (cell); 937.461.0743 fax; brian.stevens@woolpert.com

JOE CANTZ, CP, PRODUCTION MANAGER

Mr. Cantz oversees projects that range from standard photogrammetric mapping, to multi-sensor data acquisition and processing including airborne terrestrial LiDAR and digital camera and remote sensing systems. Mapping products provided include surface models, riverbed models, first generation digital orthophotos, planimetric features in a personal geodatabase, metdata, and impervious surfaces. Having worked as a compiler on both analog and digital platforms and completed aerial triangulation, editing and orthophotos, Mr. Cantz is experienced with all levels of photogrammetric production. He is experienced in the following software packages: Intergraph, DATEM and ISAT.

Mr. Cantz has extensive experience with a variety of government agencies including Departments of Transportation, FEMA, U.S. Army Corps of Engineers, and more. He has completed work in numerous states including: Arizona, California, Colorado, Ohio, Indiana, Montana, Pennsylvania, New York, Georgia, and Florida. As LiDAR team manager, his responsibilities include estimations, proposals, flight line layouts, control point selection, workflow planning for photogrammetry staff, tracking layouts, and QA\QC. He also coordinates client relations and subcontractors.

Contact Information: 4454 Idea Center Boulevard, Dayton, OH 45430.1500; 937.531.1792; 937.461.0743 fax; joe.cantz@woolpert.com

STEPHEN BOERGERHOFF, PLS, SURVEY LEAD

Mr. Boergerhoff is a licensed professional land surveyor with experience in the surveying and engineering field. His responsibilities include boundary and topographic surveys, ALTA/ACSM land title surveys, and right-of-way plats for numerous residential, commercial, and public works projects. He is proficient with AutoCAD/Land Development and MicroStation/GeoPak software.

Mr. Boergerhoff is a professional surveyor licensed in the state of Missouri # 2002000243 as well as in the states of Illinois #035-003563; Wisconsin #2751-008 and Iowa #18935.

Contact Information: 343 Fountains Parkway, Suite 100, Fairview heights, IL 62208; 618.632.7004; 618.632.0100 fax; steve.boergerhoff@woolpert.com

RUSSELL GEBHART, PILOT

Mr. Gebhart has been an aerial acquisition pilot for over 26 years and thus brings a level of expertise hard to match in the industry. He carefully plans missions for beyond more than just clear weather. Mr. Gebhart also coordinates flights for consistent coverage by matching sun angles across multiple flights & days, and for minimal shadowing by flying areas in the valleys at the highest sun angle possible & flying areas obscured by high terrain when sun is opposite the obstruction. Russ is also well versed & successful in coordinating with Air Traffic Control at such busy and difficult airspaces to ensure a mission is not lost due to restricted access to the airspace.

As the senior pilot of Woolpert's aerial photography operations, Mr. Gebhart is responsible for overseeing aircraft equipment and maintenance, estimating flight-related project costs, and assisting in the scheduling of aerial photographic missions. He works with the U.S. Geological Survey (USGS) to ensure that Woolpert's aerial camera equipment is properly calibrated. He also ensures that the firm's aircraft is in compliance with all applicable FAA regulations. He has more than 13,170 hours of flying time piloting the company's Cessna T404 aircraft equipped with company-owned Leica aerial photography cameras, LiDAR units, ADS80 digital imaging sensors and/or the firm's Wehrli 3 OC Airborne Digital Oblique Sensor.

Contact Information: 4454 Idea Center Boulevard, Dayton, OH 45430.1500; 937.477.1538; 937.461.0743 fax; russ.gebhart@woolpert.com

DOUGLAS SMITH, SENSOR OPERATOR

Mr. Smith is a member of Woolpert's aerial data acquisition team. He has a working knowledge and operates the firm's LH System Airborne Laser Sensor (ALS50-II MPiA) and Optech ALTM GEMINI System LiDAR units, Leica ADS80 Airborne Digital Sensors, the Werhli 3-OC Airborne Digital Oblique Sensor as well as Woolpert's Wild RC30 aerial camera. His duties as an imagery technician include inspection and quality control of the aerial camera; reviewing project flight specifications and layouts to ensure proper film types are used and adequate film quantities are readied for each photographic mission. In coordination with the pilot, he reviews each planned mission and performs/oversees the aerial camera operation. After the photo mission is completed, Mr. Smith prepares the exposed film for processing, gathers and documents mission data, and debriefs the project manager concerning the aerial flight mission.

Mr. Smith is also a highly skilled photo technician, producing a wide variety of photographic products. With a degree in visual communications management and professional experience in contact printing, freelance photography, and audiovisual coordination, he understands the processes and the criteria required for high-quality photographic products.

Contact Information: 4454 Idea Center Boulevard, Dayton, OH 45430.1500; 937.602.7476; 937.461.0743 fax; doug.smith@woolpert.com

KARL LEIBFACHER, IMAGERY PROCESSING SPECIALIST

Mr. Leibfacher is part of Woolpert's dynamic team of image specialists. His specialty is processing and rectifying digital data from Woolpert's digital imaging sensors - two new Leica ADS80 Airborne Digital Sensors and a Wehrli 3-OC-1 aerial oblique sensor. Karl uses GPro, POS Pac and IPAS Pro software to create SBET (Smooth Best Estimated Trajectory) solutions accurate within 10 centimeters.

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DEANNA BURTON, LIDAR SPECIALIST

Ms. Burton is responsible for supervising the team that performs airborne GPS adjustments, and then the calibration, classification, quality control, and final output generation of LiDAR data. She has numerous years of experience with GIS mapping, cartography, orthophoto and LiDAR processing software including ArcGIS, FME, IRAS C, Photoshop, Virtual Geomatics, TerraScan, TerraModeler, GeoCue, Global Mapper, MicroStation, AutoCAD, Leica GeoSystems, PLS CADD and Woolpert's Proprietary LiDAR software. She is experienced in delivering LiDAR data in numerous formats such as, LAS, ASCII, Binary, and numerous ESRI formats including file geodatabases.

She is experienced in the generation of digital terrain models, digital elevation models, contours, subsurface utility engineering drawings and utility relocation drawings, and is knowledgeable in the use of various mapping standards, such as ASPRS LAS, NMAS, NSSDA, FGDC, and FEMA's Map Modernization Guidelines.

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DOUGLAS JOOS, DIGITAL ORTHOIMAGERY SPECIALIST

Mr. Joos is responsible for digital orthophoto production including mosaicking, rectification, and quality control for various federal, state, and county clients. As a Senior Image Specialist, Mr. Joos is skilled in digital orthoimagery production. He applies standard photogrammetric techniques to process, georeference, mosaic and rectify orthoimagery from aerial photographs and digital imagery systems. He has experience with softcopy digital orthoimagery procedures using Intergraph ImageStation, OrthoVista, OrthoPro, GeoCue and TerraModel.

Mr. Joos' experience includes processing and rectifying digital data from Woolpert's two Leica ADS80 Airborne Digital Sensors using GPro. He also incorporates LiDAR data in this process. A senior member of the photogrammetry team, Mr. Joos has experience with triangulation, cartography and compilation. He possesses an excellent sense of anticipating client needs regarding complex mapping projects across disciplines.

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DIDI TACOVIC, QA/QC FINAL DELIVERABLES

As a Senior Quality Assurance/Quality Control Specialist, Ms. Tacovic is responsible for the final review of products prior to delivery to a client. She reviews for consistency and completeness of the defined delivery products and is skilled in the use of MicroStation, GeoGraphics and ArcGIS. She has been involved with numerous countywide ortho and mapping projects and recently completed the Ohio Statewide Imagery Program (OSIP), which comprised orthos covering the entire state land area (~41,276 square miles).

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MICHAEL O'LOUGHLIN, STEREO COMPILATION/PHOTOGRAMMETRIC MAPPING SPECIALIST

As a Senior Mapping Specialist, Mr. O'Loughlin is skilled in digital photogrammetric compilation. He applies standard photogrammetric techniques to georeference 3D information interpretable from aerial photographs, airborne LiDAR collectors, and digital imagery systems. Mr. O'Loughlin uses a softcopy photogrammetric workstation to update, classify, measure and record topographic and planimetric data using digital stereo photogrammetric instruments. He is experienced using the latest software including, DATEM, MicroStation, GeoCue and BAE Systems SOCET SET®. With more than 12 years' experience in photogrammetry, Mr. O'Loughlin provides compilation services for state highway projects, large-scale county sites, airport obstruction projects and industrial sites. He creates digital terrain models (DTM) and generates contours as well as collecting digital elevation model (DEM) data for digital orthophoto rectification. Mr. O'Loughlin also assists in the training of new operators and performs cartographic edits and model checks on their work.

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DARREN SHELL, STEREO COMPILATION/PHOTOGRAMMETRIC MAPPING SPECIALIST

As a Senior Mapping Specialist, Mr. Shell is skilled in digital photogrammetric compilation. He applies standard photogrammetric techniques to georeference 3D information interpretable from aerial photographs, airborne LiDAR collectors, and digital imagery systems. Mr. Shell uses a softcopy photogrammetric workstation to update, classify, measure and record topographic and planimetric data using digital stereo photogrammetric instruments. He is experienced using the latest software including, DATEM, MicroStation, GeoCue and BAE Systems SOCET SET®. With more than 25 years' experience in photogrammetry, Mr. Shell provides compilation services for state highway projects, large-scale county sites, airport obstruction projects and industrial sites. He creates digital terrain models (DTM) and generates contours as well as collecting digital elevation model (DEM) data for digital orthophoto rectification. Mr. Shell also assists in the training of new operators and performs cartographic edits and model checks on their work.

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MONICA DONOHOO, CARTOGRAPHER

As a Senior Cartographer, Ms. Donohoo is responsible for data translations, conversions, editing, processing and QA/QC of spatial information. During her career she has established data preparation procedures and a step-by-step quality control process for Woolpert's cartographers.

Ms. Donohoo designs and implements custom QA/QC processes for each individual project using Woolpert's ISO 9001:2000 procedures. She verifies that requirements for accuracy, completeness, consistency and aesthetics of mapping and GIS products are met. She is experienced using numerous types of mapping and GIS software including: MicroStation, AutoCAD, DATEM, ArcMap, GeoGraphics, GEOPAK, InRoads, TerraScan and TerraModeler. She is experienced using various types of mapping standards such as: National Map Accuracy Standards, American Society for Photogrammetry and Remote Sensing; National Standards for Spatial Data Accuracy; Spatial Data Standards for Facilities, Infrastructure and Environment; Architect/Engineer/Contractor CADD Standards; and FAA Advisory Circular 150/5300-18B.

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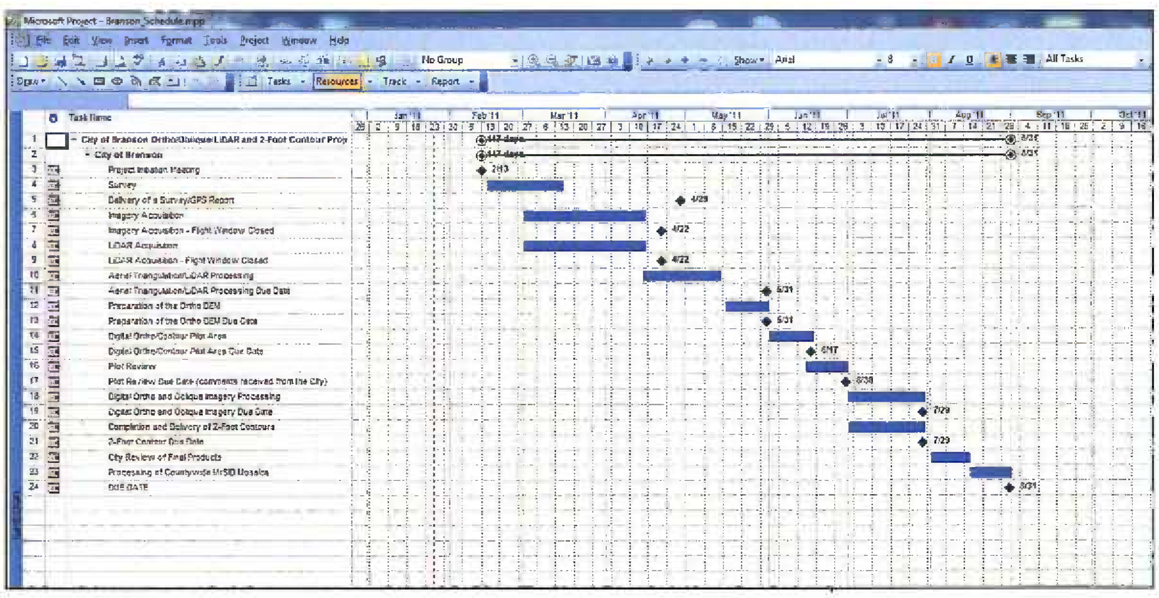
SCHEDULE



RELEVANT PAST PERFORMANCE AND REFERENCES

2009 AND 2012 DIGITAL OTHOIMAGERY PROJECT, OTTAWA COUNTY, OHIO

Client

Ottawa County, Ohio

Contact

Mike Thorbahn, GIS Manager

Ottawa County Auditor's Office

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Port Clinton, Ohio 43452

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Fee

$338,110

Date

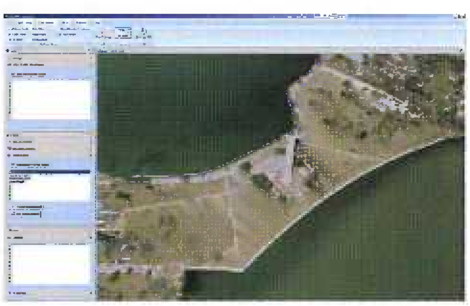
02/2009-12/2012

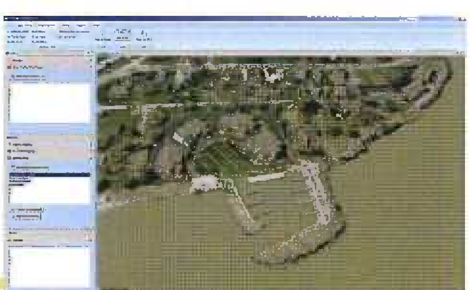
Woolpert's history with Ottawa County dates back to 1989 when we began supporting the County's need for cadastral mapping services and updating - providing them with countywide aerial photography at 1"=600' and 1"=1,200' scales and performing a Second-Order GPS control survey.

Our successful working relationship with the County continues today, most recently having been contracted to provide new countywide 1"=100' scale natural color digital nadir orthoimagery with a 0.5-foot pixel resolution and new countywide geo-referenced oblique imagery (0.5-foot pixel resolution). Details of the services performed are as follows:

Aerial Imagery Acquisition. Woolpert acquired new color digital imagery covering the entire 265.8 square mile project area including a 500' buffer zone outside the county. This aerial imagery was acquired using Woolpert's Werhli 30C Digital camera/sensor system. The imagery was acquired at a flying height suitable for the production of 1"=100' scale nadir orthoimagery with a 0.5-foot pixel resolution and oblique imagery (north-south-east-west) geo-referenced to the nadir imagery.

ABGPS/Ground Control. Woolpert used existing horizontal/vertical ground control survey along with new airborne GPS to support the digital orthoimagery production. Airborne GPS base stations were used during aerial imagery acquisition to meet the required accuracy necessary to support the orthophoto mapping.





Horizontal and Vertical Control Survey. The horizontal datum used for this project was North American Datum 1983 (NAD83 (2007)), Ohio State Plane Coordinate System, North Zone, expressed in U.S. Survey Feet. The vertical datum used for this survey was be North American Vertical Datum 1988 (NAVD88), expressed in U.S. Survey Feet.

Aerial Triangulation. Digital softcopy techniques were used for the aerial triangulation phase of this project to extend and densify the ground control.

DEM. Woolpert used existing 2006 State of Ohio supplied LIDAR data to ortho-rectify the aerial imagery.

Digital Orthoimagery. Woolpert produced new countywide color digital nadir orthoimagery at 1"=100' scale and with a 0.5 foot pixel resolution. The orthophoto tiling format follows a modular layout, with each 1"=100' scale image covering 2,500' x 2,500' as defined by even NAD83 Ohio State Plane Coordinate Gridlines. Orthophoto tiles were clipped to eliminate overlap between adjacent tiles with the approximate file size for each tile being 75 megabytes. Woolpert used an interactive mosaicking process for tone balancing and image mosaicking. Full tiles were used within the project interior with partial tiles were used along the project perimeter covering the county boundary and the buffer zone. The digital orthoimagery was produced in geotiff format with a .TIFF world file for geo-referencing. The County's existing orthophoto tiling system was used as the basis for the delivery of the new countywide color orthoimagery.

Geo-referenced oblique imagery. In addition to the nadir orthoimagery, Woolpert produced geo-referenced color aerial imagery oriented to the four cardinal directions (north-south-east-west) and captured at a 45-degree viewing angle. This imagery was delivered in strip format (based upon flight line) and segmented for ease of use (each individual segment is ~ 1GB in size). As part of this imagery delivery, Woolpert also supplied the County with image viewers which are designed to ingest and display the oblique imagery in a GIS environment.

US MARINE CORPS OBLIQUE AERIAL VIEW IMAGERY (OAV) PROJECT, VARIOUS INSTALLATIONS THROUGHOUT THE UNITED STATES

Client

US Army Engineer District, St. Louis

Contact

Robert Mesko, CEMVS-ED-S

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Fee

$850,000

Date

07/2009-10/2010

Woolpert collected and processed four-view oblique and nadir color imagery at a 4" and 12" pixel resolution of eight (8) USMC bases in the Southeast United States—for a total 635 square miles. Woolpert also provided a visualization tool for the USMC installations to use in homeland security, anti-terrorism, public safety and installation management applications. The visualization tool consists of oblique, high resolution, aerial, full color imagery of each of the eight installations.

The final data sets will be provided in a format that will allow the USMC to fully integrate the imagery with the USMC Geographic Information System (GIS) software and E911 applications. The data formatting and associated tools will permit future measuring, annotating, and overlaying other geospatial data onto the oblique imagery. The final imagery data sets will provide multiple views of any feature.

The bases were: Blount Island, FL; Townsend Range and Albany, GA; Parris Island and Beaufort, SC; Camp Lejeune and Cherry Point, NC; Quantico, VA

Ground Control. For this effort the Woolpert survey team: targeted or selected physical locations for ±126 new horizontal and vertical ground control monuments (November 2009 through March 2010); performed Airborne GPS of the new 3OC oblique aerial photography (December 2009 through March 2010); and pPerformed the necessary computations to produce the ABGPS control files for aerial photography.

Horizontal and Vertical Control Survey. The horizontal datum used for this project was WGS84, geodetic latitude/longitude coordinates, expressed in meters. The vertical datum used was North American Vertical Datum 1988(NAVD88), also expressed in meters.

Aerial Photography. During December of 2009, Woolpert initiated color aerial imagery using our Wehrili 3-OC-1 oblique digital camera system for the southern-most site and progressed northward. The imagery covers the supplied boundary for each location with the addition of a 1000' buffer outside the project boundary. The imagery was captured to support 4"/10cm pixel resolution color vertical digital ortho imagery and four-view oblique imagery for each of the nine sites and 1'/30cm pixel resolution for 95 square miles of the Quantico, VA, site.

Functionality of flight included: planimetric feature extraction of roads, railroads, rivers, lakes, vegetation, and buildings (nadir orthorectified view); and Oblique imagery: planar rectified imagery for the forward and aft views of each flight line.

Digital Elevation Model. Woolpert used the existing LIDAR "bare earth" data, along with the existing breakline data (if supplied) to produce a DEM (digital elevation model) for orthophotography rectification. The existing DEM data was evaluated and edited, as needed, in order to provide a DEM capable of producing accurate 1"=50' scale or 1"=200' scale nadir view orthophotography.

Aerial Triangulation. Mensuration was performed using Leica Geosystems GPro and ORIMA triangulation software. Our technicians used the multi-sensor triangulation software module, which incorporates automatic pass point selection, numbering, and measurement in one batch process. Pass point selection uses autocorrelation algorithms to select multiple pass points per image strip. Any pass point exceeding tolerances was filtered out to meet OIR's accuracy requirements.

To further strengthen the final aerial triangulation adjustment, Woolpert designated some ground control points as test points per each site. The test control point coordinates were withheld from Woolpert's initial aerial triangulation adjustment. Woolpert produced aerial triangulation-computed coordinates for the test control points and submitted them for comparison—fixing any errors and inserting the field-run coordinates of the test control points into the original control file and rerunning the aerial triangulation.

Vertical and Oblique Orthophotography. Woolpert has produced new vertical color digital orthophotography for the project areas at 1"=50' scale with 4-inch pixel resolution. The orthophoto tiling format follows a modular layout using the existing USMC tile grid for each facility. Vertical orthophoto tiles are clipped to eliminate overlap between adjacent tiles. Planar rectified oblique image strips overlap adjacent strips. Each 1"=50' scale oblique image strip covers a 600-meter x 1,500-meter tile and the 1"=200' scale area strips are 2,400-meter x 6,000-meter tiles.

Woolpert technicians used an interactive mosaicking process for tone balancing and image mosaicking. Full tiles were used for both the interior and perimeter of the project area. The digital imagery is being delivered in GeoTIFF format with a world file header for geo-referencing. Each of the four oblique image views are planar rectified and tiled in an overlapping modular fashion.

Horizontal Accuracy. The 4"/10cm vertical digital orthophotography meets a ±1.67' foot horizontal accuracy across the entire project area meeting National Map Accuracy Standards for 1"=50' scale mapping. The 1'/30cm vertical digital orthophotography meets a ±6.67' accuracy for 1"=200' scale mapping. The oblique view orthoimagery is within 20 pixels or less of the vertical view imagery.

On-Site Training and Data Integration. Woolpert conducted one on-site support visit to the GEOFidelis East Regional Center at MCB Camp Lejeune, NC, to in assist in the integration of the oblique imagery in the GEOFIdelis regional environment.

Data Deliverables include: one set of DEM data in shapefile format; one set of 1"=50'/200' scale color vertical digital orthoimagery at 4"/10cm or 1'/30cm pixel resolution for each ortho tile in GeoTIFF format using the supplied tiling scheme; one set of planar rectified 45-degree digital color oblique images at 4"/10cm or 1'/30cm pixel resolution for each of the four views, delivered in 600m x 1500m or 2,400m x 6,000m image tiles and in GeoTIFF format; SmartView™ Tool Set for ArcGIS; and metadata.

COUNTYWIDE ORTHOPHOTOGRAPHY, LIDAR AND PLANIMETRIC/DTM UPDATE, MADISON COUNTY, INDIANA

In 2008-2009, Madison County contracted with Woolpert to acquire new color and color infrared aerial imagery, as well as new LiDAR data of the entire 538-square-mile county. New orthophotos were produced at a 1"=100' scale with a half-foot pixel resolution. The bare earth and non-ground LiDAR data were used to update the digital terrain model and two foot contours. The following planimetric features were also updated: buildings, roads, and hydrological features.

Client

Madison County

Contact

Trent Pell, GIS Manager

16 East 9th Street

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765.641.9486 (fax)

tpell@mccog.net

Fee

$443,000

Date

03/2008 - 07/2009

Aerial Imagery/LIDAR Acquisition. New ADS 51 color digital imagery was collected over the entire 538-square-mile county plus a 1,000-foot buffer zone to produce the 1"=100' scale digital orthoimagery with a 6-inch pixel resolution. New ALS50 LiDAR was acquired over the entire 538-square-mile county plus a 1,000-foot buffer zone to produce 1-meter average post spacing LiDAR data.

The LiDAR data was processed using Flykin and Grafnav software suites to produce a highly accurate GPS track of the aircraft. It was then post-processed in accordance with FEMA's Guidelines and Specifications for Flood Hazard Mapping Partners.

Aerial Triangulation. Digital softcopy techniques for aerial triangulation were used to extend and densify ground control.

Digital Orthophotography. Woolpert produced new, color orthophotography for the area at a 1"=100' scale with 6 inch pixel resolution. Then, images were interactively mosaicked for tone balancing and image mosaicking.

Planimetric & Topographic Update. Woolpert updated the following planimetric features from the 2008 LiDAR intensity models using a systematic process: buildings, paved and unpaved roads, and hydrologic features. Using the existing DTM, 2-foot contours and spot elevations, Woolpert updated the following features: DTM, breaklines, contours, and spot elevations.

For the DTM update, Woolpert utilized LiDARgrammetry techniques.

QA/QC Update. Using the new 2009 orthoimagery as a change detection source, Woolpert identified areas of change and interactively updated them using a "heads-up" methodology for modifying buildings, transportation, and hydro features.

Project Deliverables.

- **Data:** GeoTiff tiled orthophotos, MrSID countywide image, LiDAR dataset in LAS format and ESRI shapefiles, Updated DTM, 2-foot contours and spot elevations, and planimetric data in GeoDatabase format

GEOGRAPHIC LOCATION OF PRINCIPLE OFFICES

OFFICE LOCATIONS

Woolpert has offices throughout the United States, including the headquarters in Dayton, Ohio. Project location has never been a disadvantage to our successful performance of a project, whether in the United States or overseas. By using the latest in communication technologies - e-mail, the Internet, project websites, our FTP site, faxes, modems, cellular phones, and overnight shipping services - Woolpert can stay on top of any project, anytime, anywhere.

For the city of Branson project, surveying will be performed out of Woolpert's St. Louis, Missouri, office and managed by Steve Boergerhoff, PLS, a Missouri licensed professional surveyor. The photogrammetric mapping and related services portion of this project will be performed by staff in Woolpert's Dayton, Ohio, office.

ESTIMATED COSTS

Woolpert estimates the cost of completing this project to be a guaranteed maximum lump sum fee not to exceed $104,870.

The estimated fee includes the three main deliverables (4" pixel resolution, color, digital orthophotography, 2' digital topographic mapping in a vector, ESRI-compatible format, and oblique photography), as well as, the fourth deliverable (optional LiDAR (1.5-meter average point density)).

GENERAL DESCRIPTION OF HOW THE PROJECT IS TO BE COMPLETE

As on overview, Woolpert will complete the project as follows:

1. Meet with the City of Branson and prepare a final work plan.
2. Prepare final flight maps and ground control diagrams.
3. Execute ground control and aerial acquisition of imagery and LiDAR.
   - Perform recon, placement of targets/PIDs and perform GPS observations
   - Acquire aerial imagery and LiDAR
   - Perform QC on the aerial imagery and LiDAR
   - Schedule re-flights, as necessary
   - Provide a copy of the QC imagery to the City of Branson for acceptance and invoicing

4. Perform aerial triangulation and process the ground control coordinates
5. Perform LiDAR processing and review
6. Select and perform a pilot project (determine the area with the City of Branson)
7. After pilot review and acceptance, initiate full production tasks
8. Initiate image rectification and ortho QC (upon completion prepare final ortho tiles)
9. Initiate processing of the four cardinal direction oblique imagery
10. Perform LiDAR QC and prepare final LiDAR deliverable (in the appropriate tiling system)
11. Create stereo imagery and initiate the production of a DTM to support 2-foot contours
12. Upon completion of the DTM, initiate processing of the 2-foot contours and prepare for QC
13. Perform QC on the citywide 2-foot contours
14. Perform final QC on all deliverables and ship to the City of Branson
15. Upon acceptance of the deliverables (LiDAR, orthos and 2-foot contours), processing of the citywide MrSID imagery will be initiated, as will processing of the secondary imagery products (i.e. TIFFS, ECW) for the oblique imagery viewers (stand-alone and ArcGIS Extension).
16. Perform a closeout meeting with the City

Note: Communication between the City of Branson and Woolpert will be continuous from project award notification through project closeout.

PRINTED ON RECYCLED STOCK

MEMORANDUM

February 11, 2011

To:	Capital Improvements Committee	
From:	Mike Ray Utilities Director	David Miller City Engineer
Subject:	Meadow Ridge	

This memorandum and the attached documents provide information regarding the Meadow Ridge subdivision located at the northwest city limits of Branson and along Sycamore Church Road. An overview map of the area is attached. The Meadow Ridge POA is requesting assistance resolving non-compliance issues of the development's sewer treatment plant that has resulted in enforcement action by Missouri DNR. Upgrading or replacing the existing plant has been evaluated; however, connecting their existing sewer collection system to the City of Branson appears to be the option desired by the POA. The Taney County Sewer District, City staff and the Ozark Clean Water Company (OCWC), who owns a sewer interceptor serving the Roark Valley watershed between Stonebridge and the Branson sewer system, have met and discussed this matter in an effort to seek a viable solution.

The Sewer District has committed to build a sewer line extension from the existing interceptor to Meadow Ridge for connection to Branson. OCWC has made an agreement with the Meadow Ridge POA to operate the Meadow Ridge collection system if Branson agrees to treat the sewer. OCWC would be recognized by DNR as a continuing authority and responsible party for operation of the collection system. The Meadow Ridge collection system is made up of a combination of gravity and low pressure sewer mains.

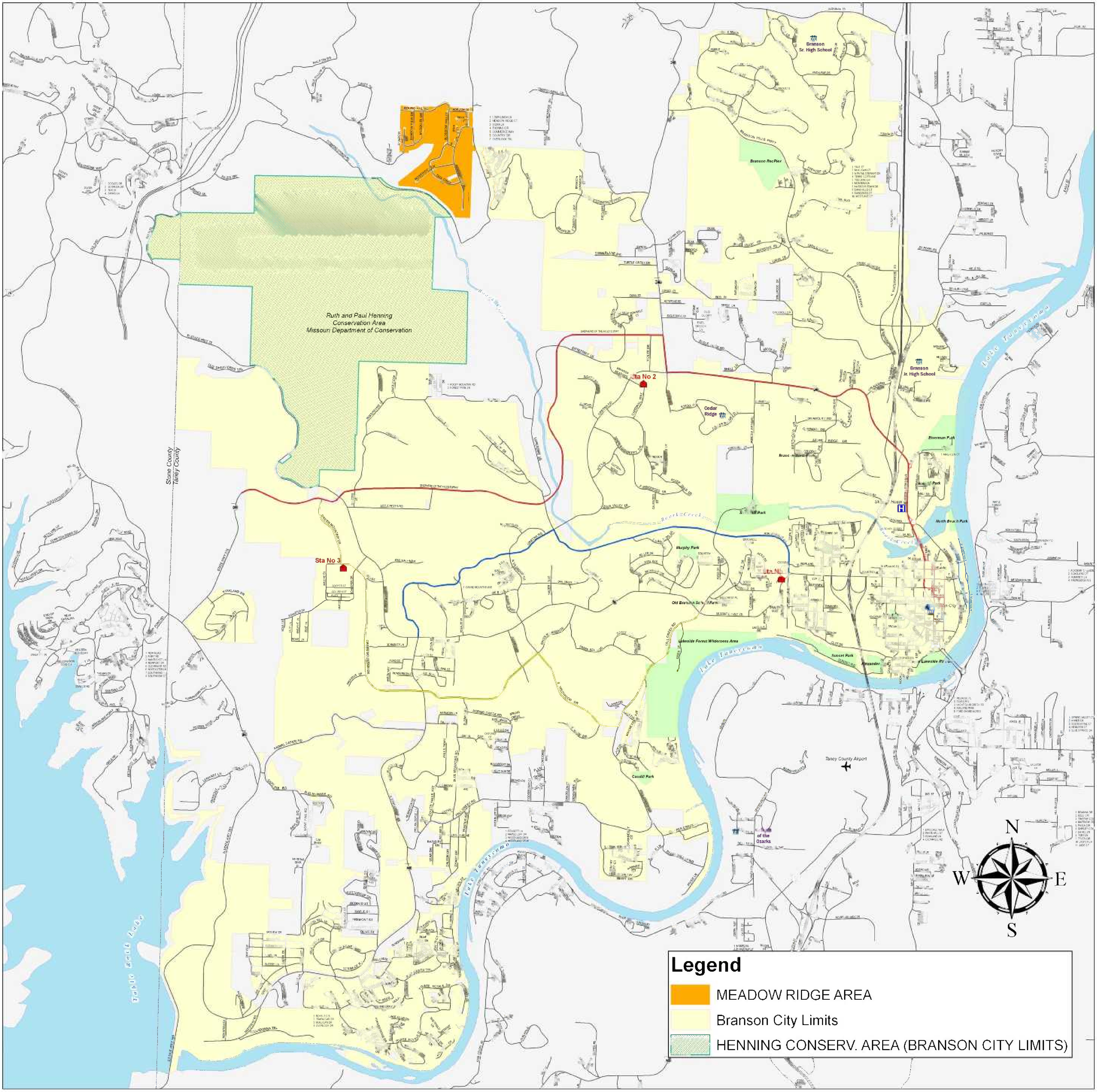
In 2005 Branson entered an agreement with OCWC to treat sewer flows from the Stonebridge development and, if capacity exists in the Branson system, OCWC also has the right to connect other developments located in the Roark Valley watershed, such as Meadow Ridge to the Branson system.

Factors and considered concepts for further discussion regarding the connection of Meadow Ridge are as follows:

- The Meadow Ridge development consists of 300 residential lots. 284 lots are developed with single family dwellings.
- Existing treatment plant design is 90,000/day. Current records indicate flows are averaging 60,000/day.
- Capacity is currently available in the Branson system to treat the Meadow Ridge flows. Flow information is attached in WWTP Compton Basin.
- Sewer capacity fees would currently be assessed at $250.00 per existing home.
- User rates would be charged at 2.5 times the inside city rate unless other arrangements are made.
- The Meadow Ridge development is contiguous to city limits on the south and east sides.
- Under the OCWC agreement only new construction in the Roark watershed has to agree to sign an annexation petition. Meadow Ridge is not considered new construction by OCWC.

- Annexation does not appear to be in the best interest of the city at this point, however, it may make sense in the future.
- Staff has discussed the requirement of an annexation agreement that would provide the city the ability to annex the development in the future. Since the OCWC agreement has wording that exempts this requirement a lowered user rate could be considered as an incentive for property owners to agree to this concept.
- Monthly billing for sewer would be calculated from flows measured through a master flow meter that would be located in the new line extension at the point of connection to the existing interceptor.
- An excessive flow surcharge is also being considered for high flows resulting from infiltration being allowed into the Meadow Ridge system.
- Inspection for quality would be necessary of the existing Meadow Ridge system for proper material types and installation. Any deficiencies would need to be repaired prior to connection.

Connection of Meadow Ridge to the Branson system would be a good decision for environmental reasons, however, staff has proceeded cautiously giving consideration to other factors that could impact future operational costs, capital costs and comprehensive planning.



Ruth and Paul Henning
Conservation Area
Missouri Department of Conservation
Stone County
Taney County
Branson Sr. High School
Branson Jr. High School
Branson RecPlex
Sta No 2
Sta No 3
Cedar Ridge
Murphy Park
North Beach Park
Lakeside Forest Wilderness Area
Sunset Park
Cantrell Park
Taney County Airport
Lake Taneycomo
Table Rock Lake
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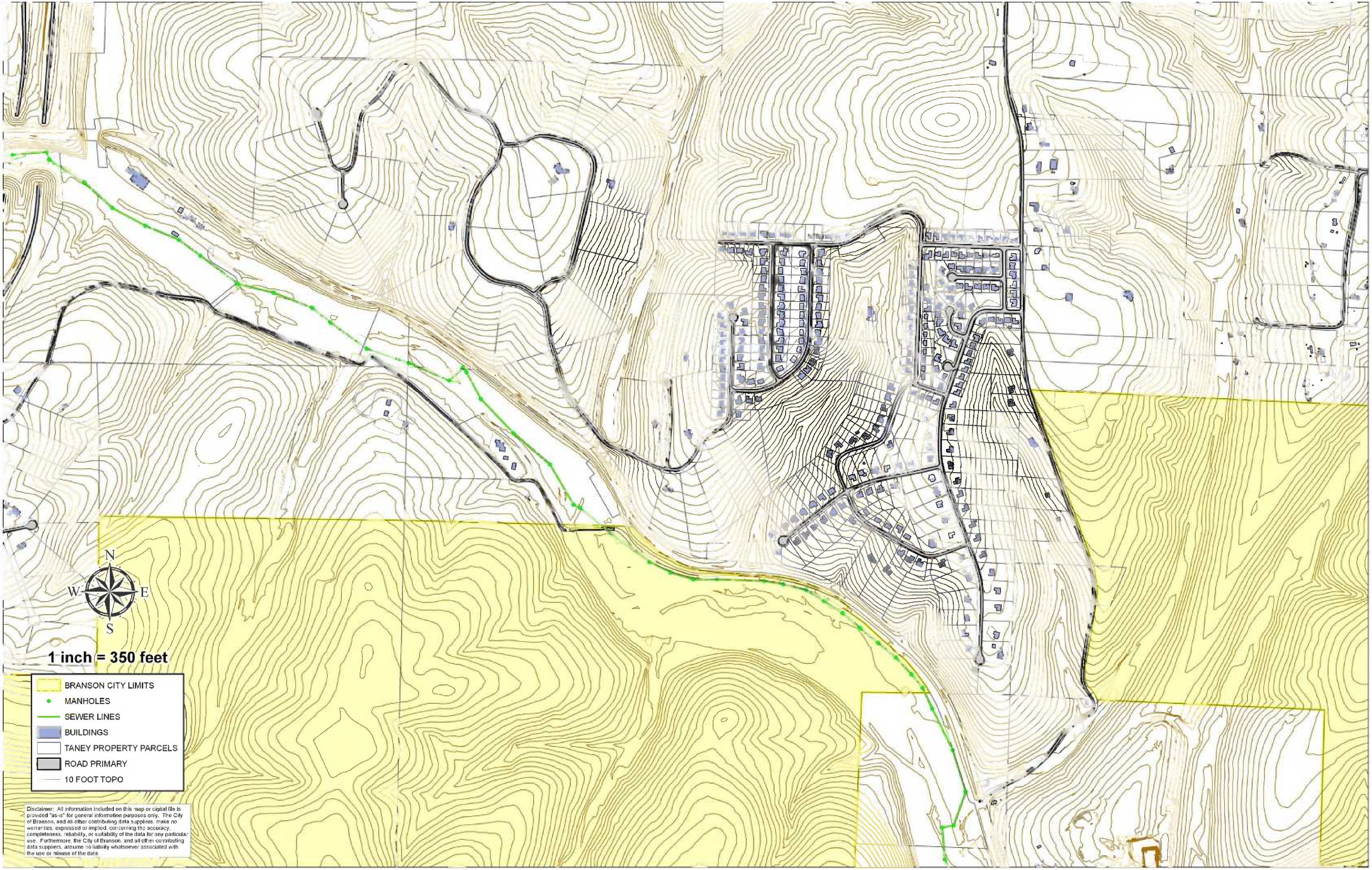
MEADOW RIDGE AREA
Branson City Limits
HENNING CONSERV. AREA (BRANSON CITY LIMITS)


N
S
E
W
1 inch = 350 feet
BRANSON CITY LIMITS
MANHOLES
SEWER LINES
BUILDINGS
TANEY PROPERTY PARCELS
ROAD PRIMARY
10 FOOT TOPO
Disclaimer: All information included on this map or digital file is provided "as-is" for general information purposes only. The City of Branson, and all other contributing data suppliers, make no warranties, expressed or implied, concerning the accuracy, completeness, reliability, or suitability of the data for any particular use. Furthermore, the City of Branson, and all other contributing data suppliers, assume no liability whatsoever associated with the use or misuse of the data.

WWTP Compton Basin:		**Gallons/Day**	
	Meadow Ridge	90,000	
			90,000 Total Gallons = 300 connections @ 300 gallons
			$1,800 to $2,100 per residential connection
			Approximate city capacity cost $540,000 to $630,000
Total:		90,000	
Compton WWT:	**Design Treatment Capacity**	5,300,000	
	Current Capacity Permitted	5,166,352	
	Remaining Permit Capacity:	133,648	
	Adding Meadow Ridge	90,000	
	Remaining Permit Capacity	43,648	
	Annual Average Daily Flow		
	July 2009 to July 2010:	2,410,000	
	Adding Meadow Ridge	90,000	
	Total Flow	2,500,000	
	Remaining Capacity:	2,800,000	
	Highest Dry Weather Flow		
	July 2009 to July 2010:	2,924,000	
80 % of Treatment	Adding Meadow Ridge	90,000	
Capacity - 4,240,000	Total Flow (57% of Capacity)	3,014,000	
	Remaining Capacity:	2,286,000	
	Design Peak Flow Capacity	10,600,000	
	Wet Weather Peak Flow		
	In June 2008 Estimate	8,500,000	
2.5 Times Daily Average	Adding Meadow Ridge	225,000	
	Total Flow	8,725,000	
	Remaining Capacity:	1,875,000	
Lift Station 30:	**Max Design Flow: (1 pump)**	1,512,000	
	Average Daily Flow		
	From July 2009 to July 2010:	597,000	
	Adding Meadow Ridge	90,000	
	Total Flow	687,000	
	Remaining Capacity:	825,000	
	Highest Dry Weather Flow		
	From July 2009 to July 2010:	764,000	
	Adding Meadow Ridge	90,000	
	Total Flow	854,000	
	Remaining Capacity:	658,000	
	Max Design Peak Flow: (w/EQ)	2,512,000	
	Wet Weather Peak Flow		
	From July 2009 to July 2010:	1,226,000	
	Adding Meadow Ridge	225,000	
	Total Flow	1,451,000	
	Remaining Capacity:	1,061,000	
10-Jan-11			

CITY OF BRANSON, MISSOURI

Capital Improvement Program
Construction Status Report

Date: 2/14/11

Project #	Project Name	Type/Phase	Construction Budget	Contract Amt. to Date	% Complete	Contractor Arch/Eng	Total Change Order Amt	% change	Notice to Proceed	Anticipated Completion	Comments
SEWER											
EN1001	Lift Sta. #30 Capacity Upgrade	Construction	$3,133,276.00	$2,856,239.82	91%	Rosetta			4/19/2010	3/1/2011	Progressing well. Lift station work underway. Eq basin complete
ENG39	Compton WWTP Exp	Construction	$4,507,000.00	$2,646,171.10	59%	Branco	-$3,422.00	-0.1%	4/27/2010	3/1/2011	Complex construction will soon begin to tie in to existing system
	Fall Creek Resort Reconstruction	Design	$332,500.00			To Be Determined				12/31/2011	RFP Process Underway
	Antidegradation Study	Study	$35,524.00			Black & Veatch			12/21/2010	7/1/2012	Study underway
	Whisper Cover Sewer	design	$36,000.00			To Be Determined				12/31/2011	Engineer selection to proceed in Spring
	Lift Sta #25	Design	$385,000.00			To Be Determined				12/31/2011	RFP Process Underway
SW1004	Lift Sta. #9 Improvements	Design & Study	$47,150.00	$24,113.02	51%	HDR			9/29/2010	7/1/2011	Study complete. Design underway
WATER											
SW1001	2" Water Meter Replacement	Construction	$139,344.00	$93,408.21	67%	Northwest Utility			7/20/2010	4/20/2011	217 meters changed to date.
BUILDINGS											
PO1002	Police/Courts Facility Expansion	Construction	$52,513.00	$52,513.00	100%	Winslow Const.	$1,386.81	2.6%	3/15/2010	12/30/2010	Construction complete
EN1003	City Clerk Modifications	Construction	$149,164.00	$0.00	0%	Winslow Const.	$750.00	0.5%	8/6/2010	3/31/2011	On schedule
TRANSPORTATION											
ENG23	Hwy. 248/65 Diverging Diamond	Design	$45,274.00	$27,304.99	60%	DRG			1/12/2011	3/15/2011	Redesign contract to council for first reading 12/14/10 for detour of ramps
EN1002	Pedestrian Improvements	Construction	$79,937.00	$44,427.50	56%	Brock's Concrete	$7,417.50	9.3%	8/2/2010	3/31/2011	Change Order to council 12/14/10
	Veterans Blvd Bridge repairs	Design	$50,000.00			To Be Determined				7/1/2011	Engineer selection to proceed in Spring
	Thermoplastic Road Striping 2010	Construction	$27,700.00	$23,607.95	85%	Time Striping			10/4/2010	12/31/2010	Complete
	Painted RoadStriping 2010	Construction	$23,202.00	$22,151.72	95%	Time Striping			10/4/2010	12/31/2010	Complete
MISCELLANEOUS											
	orthophoto	Design	$125,000.00	$0.00		To Be Determined				9/1/2011	RFP Process Underway
	Tennis Court Resurfacing	Construction	$20,000.00	$0.00		To Be Determined				7/1/2011	Bid in spring
	Garage Roof Repairs	Construction	$20,000.00			To Be Determined				7/1/2011	Bid in spring
	Stormwater Improvements	Design	$150,000.00			To Be Determined				12/31/2011	Engineer selection to proceed in Spring
	Sunset Walking Path Overlay	Construction	$22,000.00	$0.00		To Be Determined				7/1/2011	Bid in spring
	Campground Site improvements	Construction	$24,000.00	$0.00		To Be Determined				7/1/2011	Bid process underway

FINAL CHANGE ORDER

Project Name Police Department Renovations Project No. 10-185

Contractor

The below noted modifications to subject Contract are directed by Owner and accepted by Contractor:

1.	Relocate 1 sprinkler head per Fire Marshall's direction	$ 202.50
2.	Add 2 Troffer lights in DARE Room #110	$ 371.25
3.	Credit deletion of cabinetry in Ready Room #105	$ (600.00)
4.	Add Thermostat in DARE Room	$ 97.50
5.	Remove & Replace VCT & Vinyl base in workroom	$ 1,315.56

The modifications noted above result in (increase of) (~~decrease of) (no change~~) ($ 1,386.81) in
Contract Price, the current Contract Price being: $ 52,513.00
Original Contract Price .... $ 52,513.00
Total net amount of all previous Change Orders ....(+ or -)$ -0-
Total net amount of all previous variable quantity adjustments ......(+ or -)$ -0-
Total net amount of this Change Order ....(+ or -) $ 1,386.81
Current Contract Price Including this Change Order......................(+ or -) $53,889.81

The Contract Time shall be (increased) (~~decreased) (unchanged~~) (by 48 days), the current
Completion Date being: January 5, 2011
Original Completion Date ....November 19, 2010...

Total net time adjustment of all previous Change Orders .... (+ or -) -0- days
Total net time adjustment of this Change Order .... (+ or -) 48 days
Current Completion Date including this Change Order .... (+ or -) January 5, 2011

The price and/or time extension set forth in this Change Order is full compensation for all costs and delays, direct and indirect, incurred in connection with the conditions giving rise to this Change Order, the work specified herein, and any consequential costs, delays or effects on unchanged work resulting therefrom.

This Change Order, when executed, constitutes a modification to the Contract and all provisions of the Contract, except as modified above and by any previous Change Orders, shall apply hereto.

OWNER – City of Branson

By Dean Kruithof
Dean Kruithof
City Administrator

Date 1-20-11

CONTRACTOR – Winslow Const. Mgmt.

By [signature]
Chad Sovia
Project Manager

Date 12/30/2010

APPROVED AS TO FORM:

[signature]

By: William T. Duston, City Attorney